Carbon dioxide flux meter
Continuous Monitoring
Handbook

Release 10.1
December 2007

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ITALY

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If your equipment requires maintenance in Italy:

BEFORE YOU SHIP THE INSTRUMENT BACK TO ITALY REMEMBER:

- When you ask your shipping agent to send the instrument to Italy check that on the Air Waybill the Airport of destination is **PISA.** Any other airport of destination creates a lot of problems in delivering the items (delay, costs, custom problems etc.)
- Check that the Company your shipping agent chooses lands in Galileo Galilei Airport in Pisa. If not, ask your shipping agent to change the Company or send the items by DHL or UPS or FedEx.
- Mark each item with a serial number, if not already present, and write this number on the document (proforma or original invoice or item list) where you list the parts you are sending back to Italy.
- Specify a correct value of the parts you are sending back in the documents mentioned above.

Pay attention to these rules because Custom law in Italy is very complicated and probably different from your Country.
If you follow these suggestions everything will be easier for you and for us.

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The package contents

Goods	Description	S/n	Quantity	Check
Sensors	Polytron IR CO2	DRGEEX02	1	
	Vaisala Pt100	C1130006	1	
	AirBox		1	
	SoilBox		1	
	WindSonic	WIND00075	1	
	RainGauge	Pluvio116	1	
	ThermoHygrometer		1	
	TDR CS616	CS6161_21	1	
	Pt100 Soil temperature		1	
	AWM3300	C714	1	
	dP gauge		1	
Shelter	Shelter		1	
	Feet		4	
	Piquets		12	
Telemetry	Backfire antenna		2	
	Coax 3 meter N-N		1	
	Coax 10 meter N-N		1	
	SSR24 Slave	2427581	1	
	SSR24 Master		1	
AC	Accumulation chamber		1	
	AC.Box		1	
P.Supply	Solar cell regulator		1	
	12V 40A/h battery		1	
	Solar cell		1	
FluxStation	FluxStation		1	
	AC Board		1	
	PowerBoard		1	
	CPU Board		1	
	Pump KNF/ST		1	
Tools	Piquet-prolongue		1	
	Wrench kit : 13/17		1	
	Hexagonal wrench		1	
	Tie kit		1	
Spares	Spare filters 1"		4	
	Spare filters 2"		2	
	Spare rilsan tube		1	
	mt silicon tube		2	

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Safety information

Carbon dioxide is a TOXIC GAS,
Carbon dioxide is colorless, odorless, tastless and is heavier than air. Air concentration higher than 5000 ppm can cause dizziness, shortness of breath, rapid pulse. Higher concentrations of carbon dioxide can be **lethal.**

Diffuse carbon dioxide fluxes are normally related to anomalous carbon dioxide air concentration. The user must verify the safety conditions before entering dangerous areas using specific and approvated instrumentation.

The Fluxmeter described in this manual is designed to measure diffuse emission of soil gases and CANNOT be used for different purposes expecially if related with safety.

The instrument and the electronic accessories are NOT designed to work in explosion risk areas.

Hints

About installation

Before to start the installation of the FluxStation is better to install the Master center telemetry systems and to setup the Scada software suite on the computer.

The onfield installation is described on chapter 2.

Fluxstation & computer clocks synchronization

The FluxStation clock can be not synchronized with the computer one; then, since the telemetry is normally off, to save the battery energy, except for a 5 minute period after the station analisys cicle, a synchronization is necessary, else when the computer will try to call the FluxStation, via telemetry, the remote telemetry system will be off.

To perform the synchronization:

1) Set the PDA (PalmTop computer) clock with the time you'd like to use (Local / GMT , ect.);

2) After the FluxStation installation set the clock of the FluxStation using SetStation on the PDA;

3) Set the computer clock.

About carbon dioxide flux

The flux phenomena can be perturbated by the installation, because digging the soil, hammering , placing the collar ect..
The "normal" regime will be restored in few days.

On-Field Installation

Installation

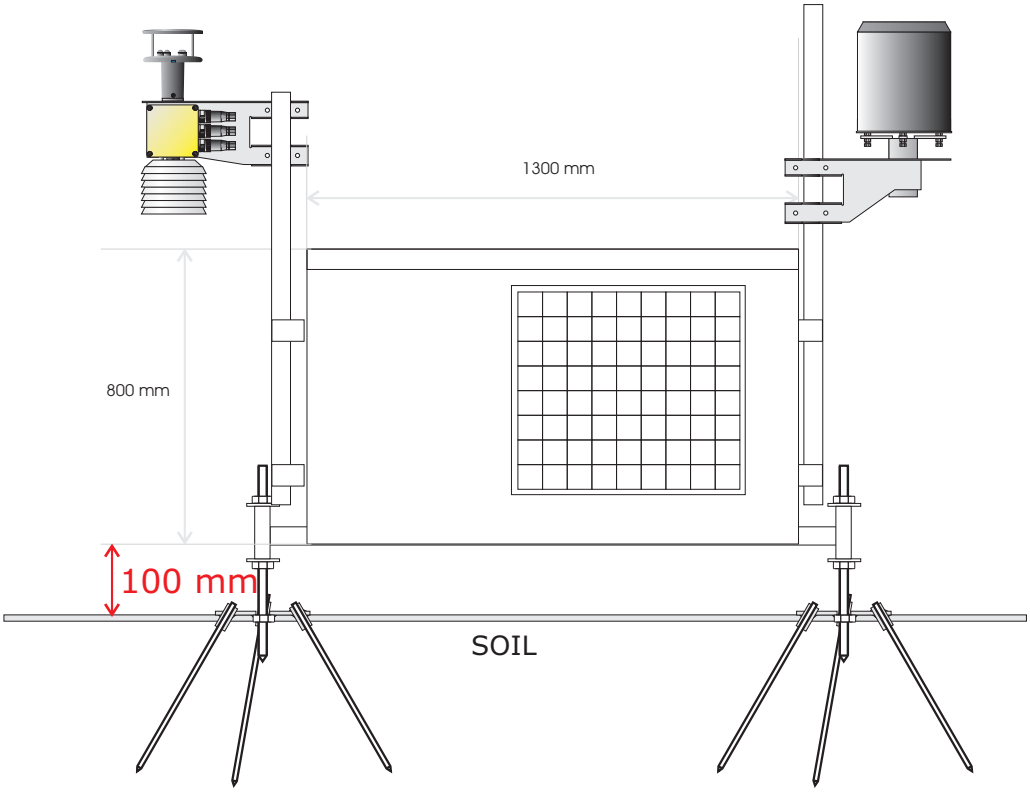
Select the installation site after a carbon dioxide flux survey. The best location is in the middle of an anomalous efflux area with an homogeneous flux distribution.The optimal flux value is in the range from 2 to250 moles per square meter per day. For the choice of the site it is necessary to take into account that the solar panel has to be oriented toward in the correct direction and that it must be exposed to sunbeams at least for 4-6 hours per day.It is necessary to take into account also the functioning of the telemetry system.

In case you are using GSM telemetry please verify the coverage and the signal strenght using a mobile telephone with a SIM card of the provider you choose for data transmission. In case you use a SSR24 telemetry from the selected site you must have a very good direct visibility of the Master Center or of the site where you will install the radio repeater bridge if necessary.

Moreover it is necessary to evaluate the soil stability and the possibility of flooding.

If besides the carbon dioxide emission also strong water vapour emission are present it is necessary to evaluate the possibility of installation of a water condensing system along the gas sampling line.

Install the box wit the solar panel orienteded by means of a compass. Fix the sensors and antenna poles , the different sensors, the accumulation chamber and then the station. Following the instructions described in the next pages connect the different devices.

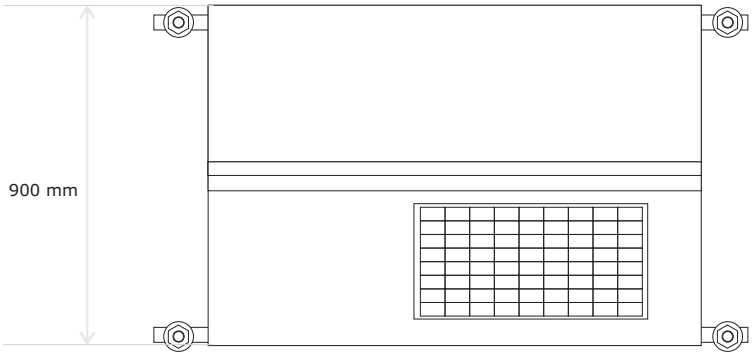


The base of the shelter must be 10 - 15 cm far from the soil, else the lenght of the accumulation chamber cables could be not enough.

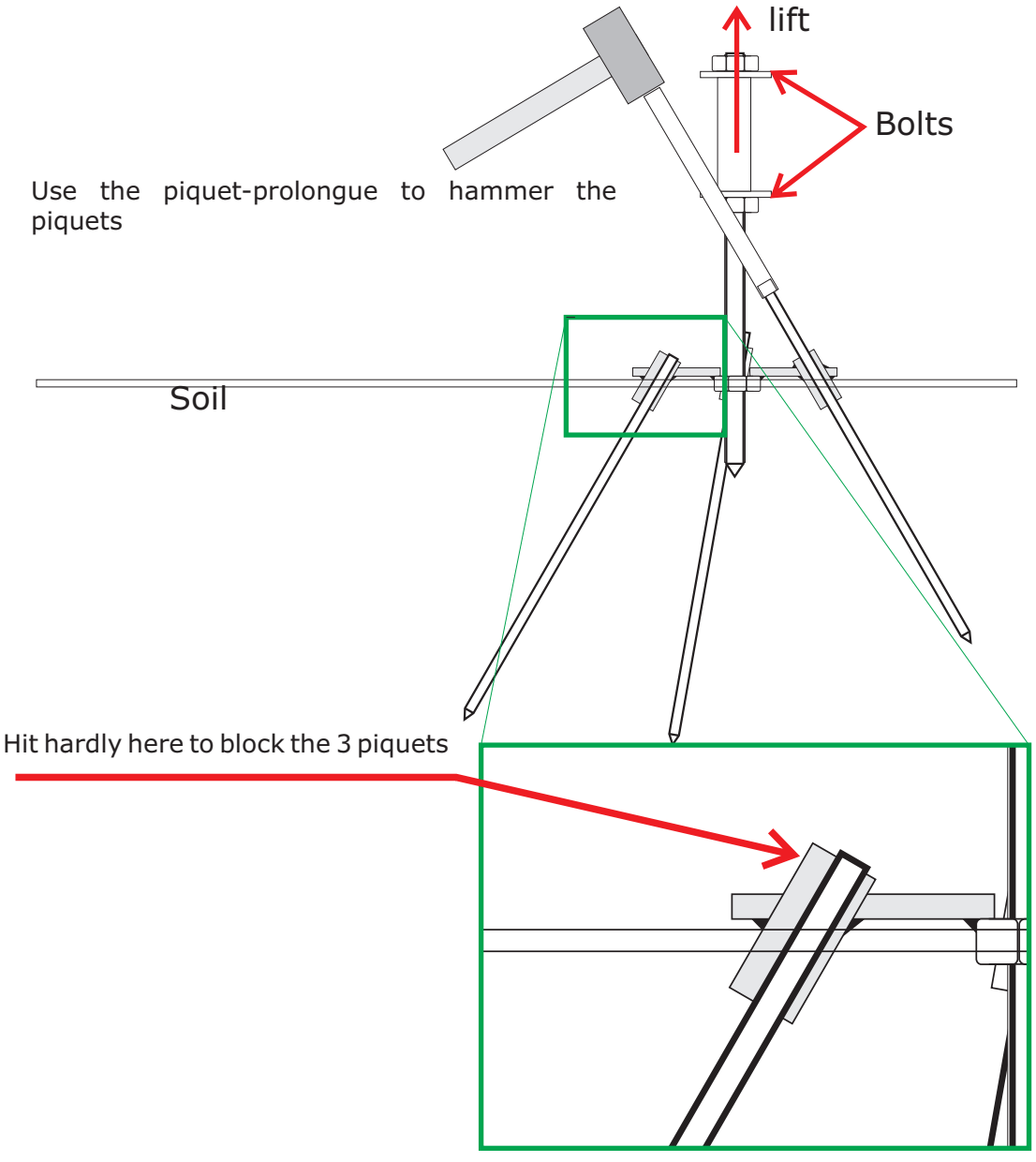
The 10 cm distance allows a good circulation of atmospheric air in the accumulation chamber area, else the entire shelter become a big accumulation chamber....

On-Field Installation

In the drawing the top view of the protection box (DHW), the sensor are not showed.

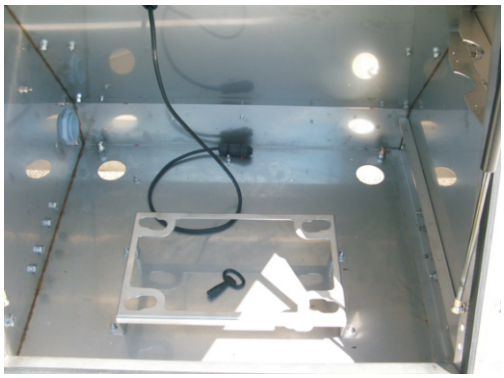


To place the piquets: Unscrew the bolts and lift at the maximum elevation the shelter: After the installation of piquets down to the shelter at 10 cm distance from soil.

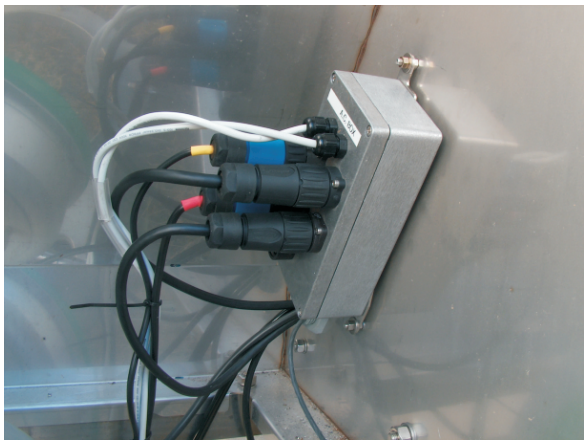


On-Field Installation

In the picture one of the four stand with the 3 piquets. The soil on the picture is not exactly a "soft" soil...



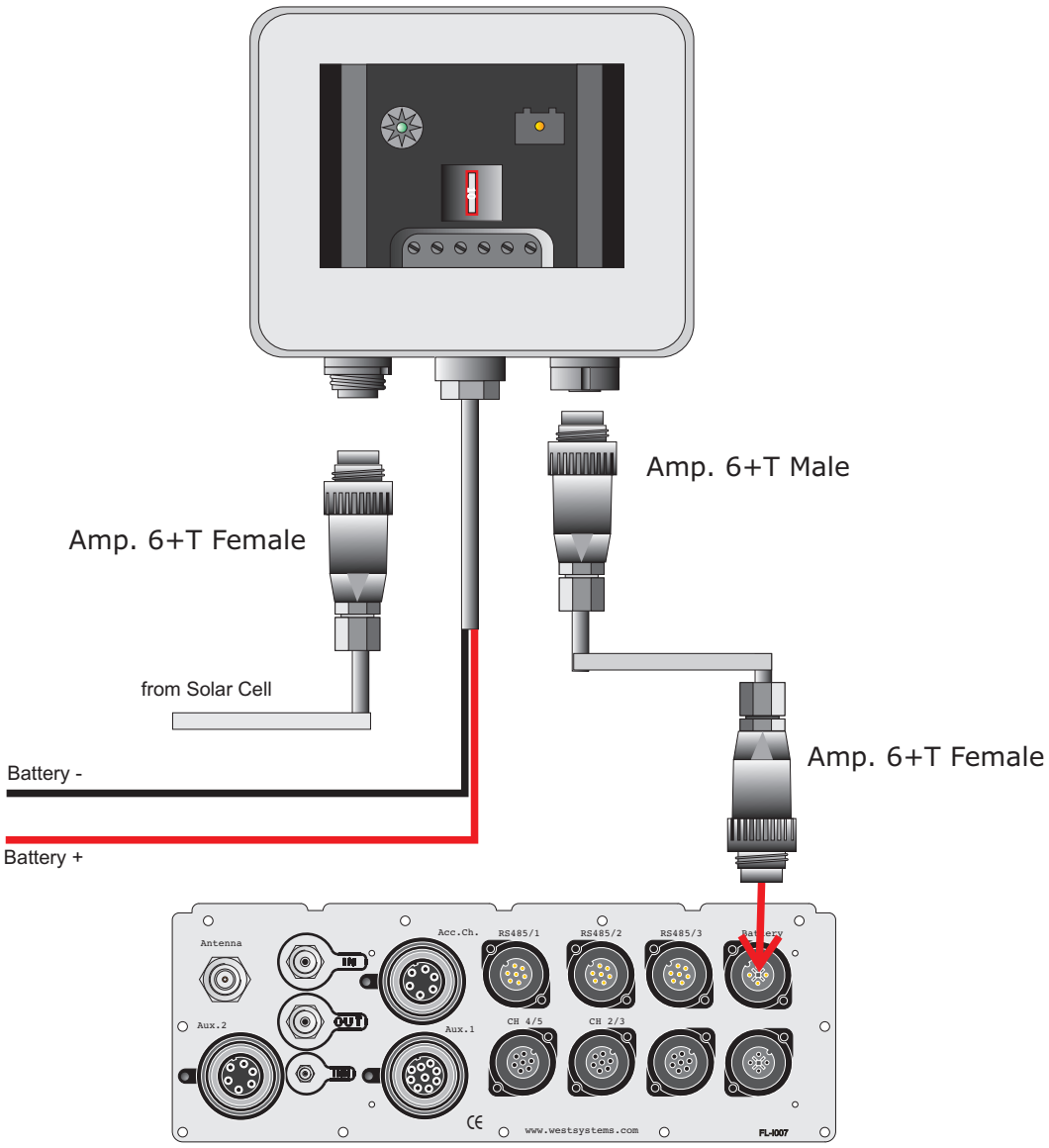
In the picture the "chair" for the FluxStation case that must be mounted on the right part of the shelter to put the fluxstation in a accessible position.



In the picture the accumulation chamber connection box, that must be mounted on the shelter close to the accumulation ch.

On-Field Installation

Power supply



Power supply cable

Pin	Function	Color
1	+12V	Red
2	Gnd	Black
3	n.c.	
T	n.c.	

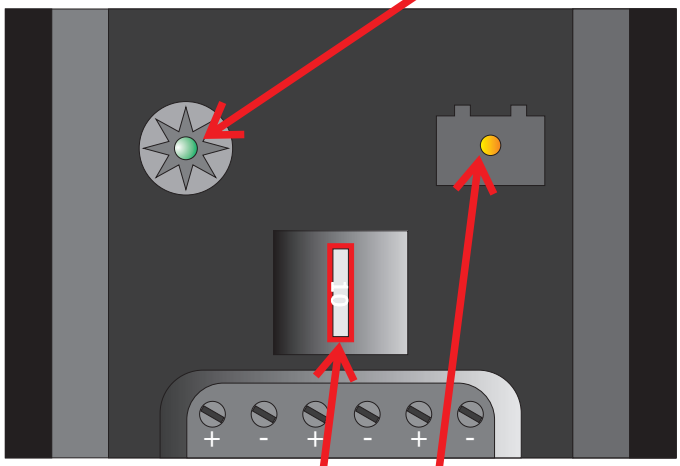
Solar cell cable

Pin	Function	Color
1	n.c.	
2	Gnd	Black
3	+12V	Red
T	n.c.	

On-Field Installation

Solar cell charge regulator

The LED light is ON when the solar cell is exposed to sunlight



The LED light is:
Green when the battery is full
Yellow normal charge
Red when the battery is empty

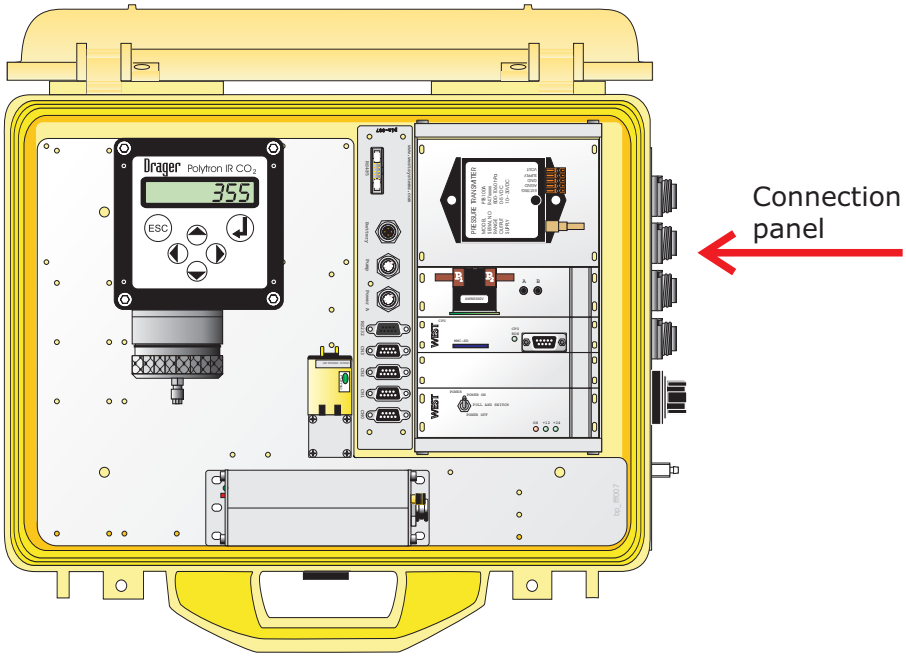
10 Ampere fuse (car type)

If the battery voltage fall down to 11.1 Volt the charge regulator turn off the load (the flux station) in order to save the battery against the overdischarge. The load will be reconnected when the battery voltage grows up to 12.6 Volt.

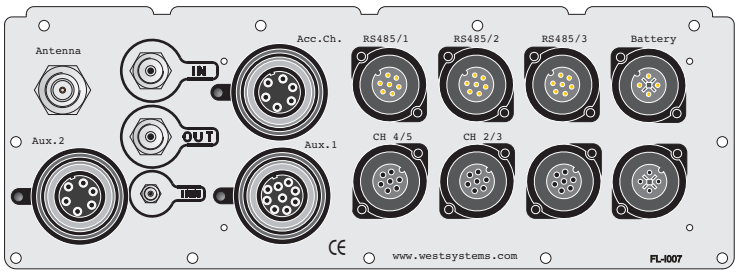
If the battery voltage fall down to 11.1 Volt the charge regulator turn off the load (the flux station) in order to save the battery against the overdischarge.

On-Field Installation

Connections



All electrical and pneumatic connections to the flux station are on the left side panel.



Follow the instruction on the next pages for the connection of the detectors and devices to the flux station.

On-Field Installation

The external sensors connections:

The FluxStation is supplied with several meterological and soil parameters sensors:

- Air temperature and relative humidity;
- Wind speed and direction;
- Rain fall gauge;
- Soil temperature;
- Soil water content;

The FluxStation is supplied with several meterological and soil parameters sensors:

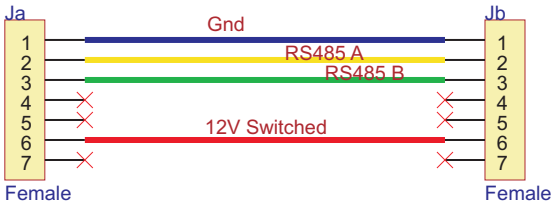
Some of them are managed by the AirBox:
- Air temperature and relative humidity;
- Wind speed and direction;
- Rain fall gauge;

and the others by the SoilBox:
- Soil temperature;
- Soil water content;

SoilBox and AirBox , described in detail in the Appendix S and Appendix A, are connected with the FluxStation using a RS485 cable:

RS485 cable

Ja Amphenol 6 + T Pin Female Jb Amphenol 6 + T Pin Female



RS485 Cable

Pin	Function	Color
1	Gnd	Blue
2	RS485 A	Yellow
3	RS485 B	Green
4	n.c.	
5	n.c.	
6	+12V	Red
T	n.c.	

The FluxStation RS485 connectors

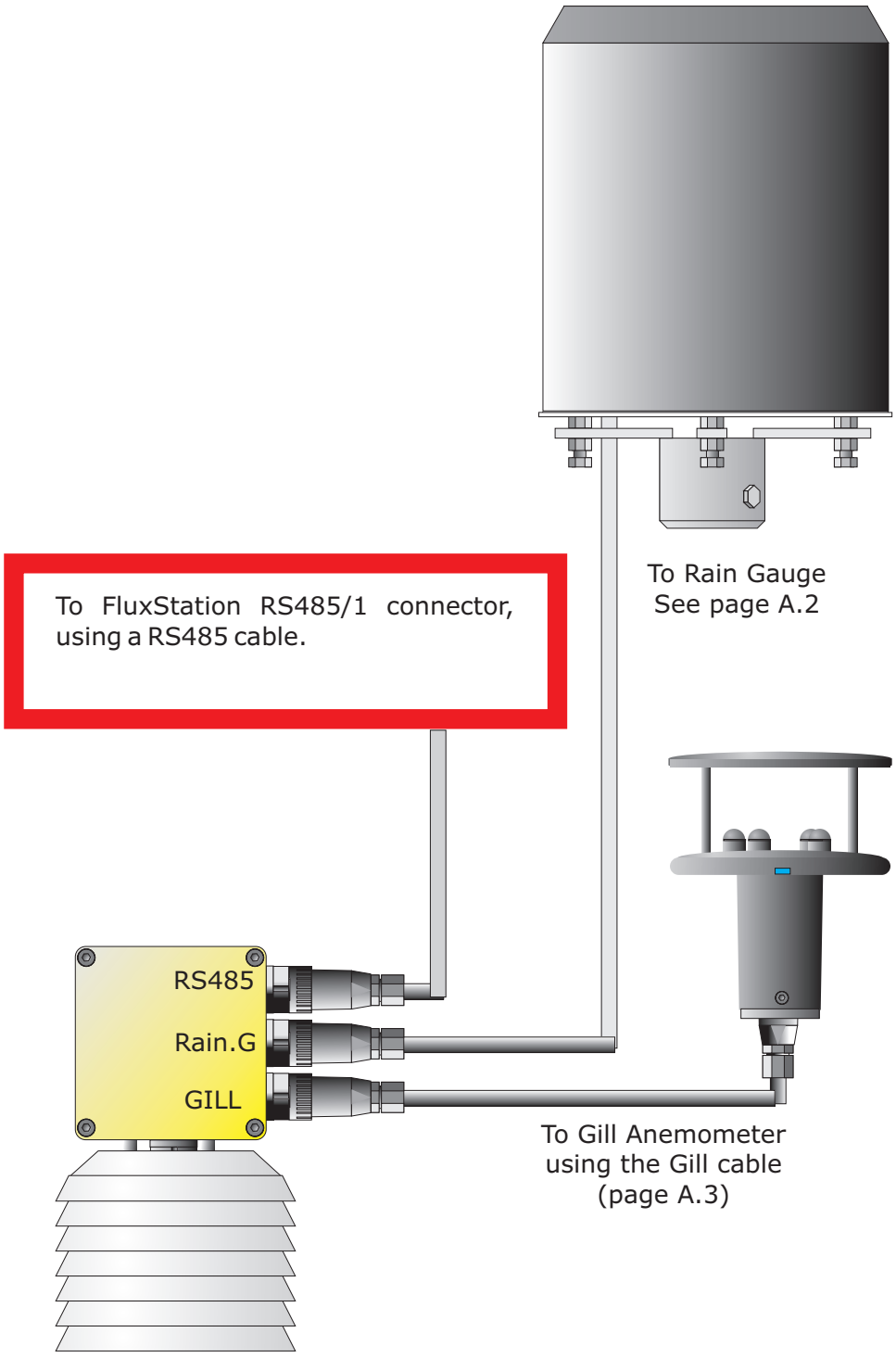
The FluxStation is equipped with 3 RS485 connectors , marked as RS485/1, RS485/2, RS485/3;

RS485/1, 2 and 3 have the same pin-out and the same function.

On-Field Installation

Meteorological detectors: AirBox

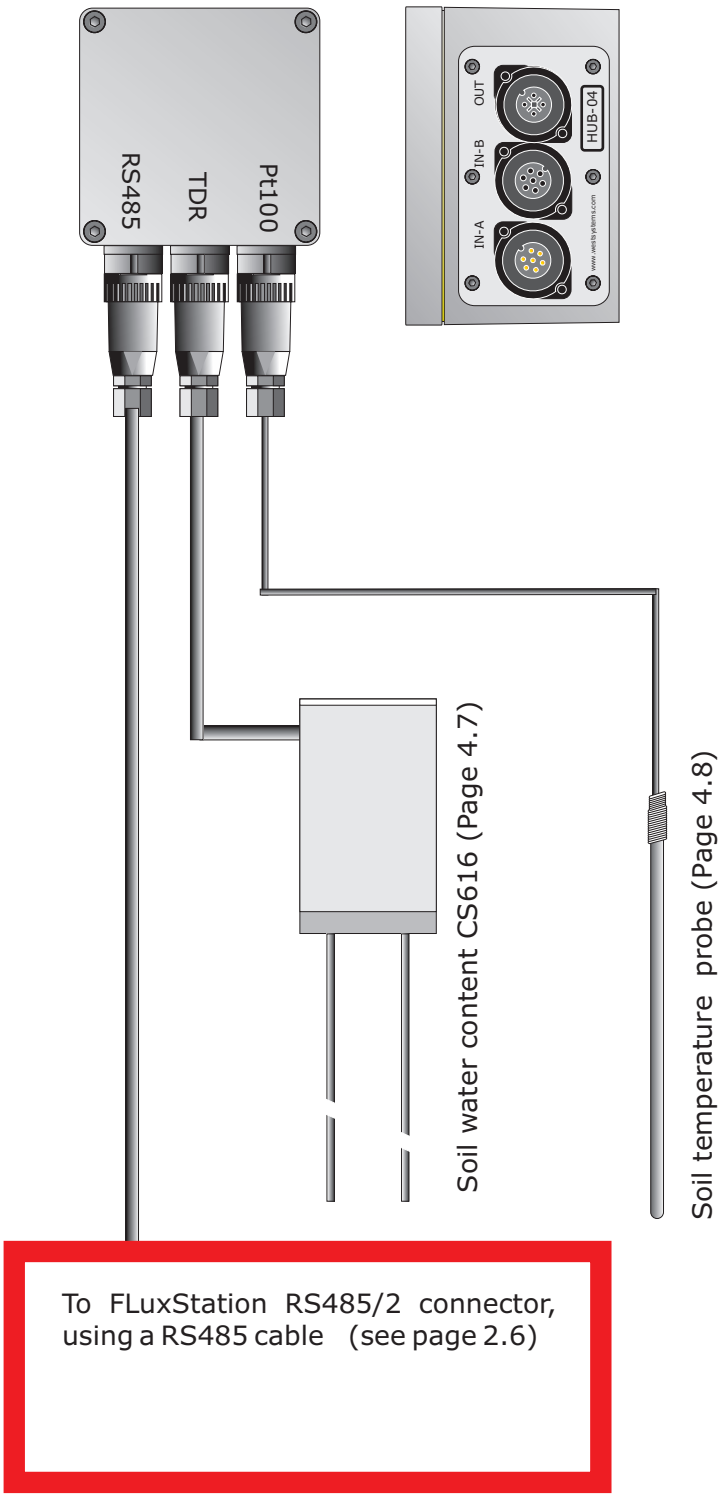
The air box is a new interface described in detail in the appendix A that allows the use of the new sonic wind speed and direction gauge as well as the new air temperature and relative humidity digital probe.
A rain gauge can be connected to the AirBox.



On-Field Installation

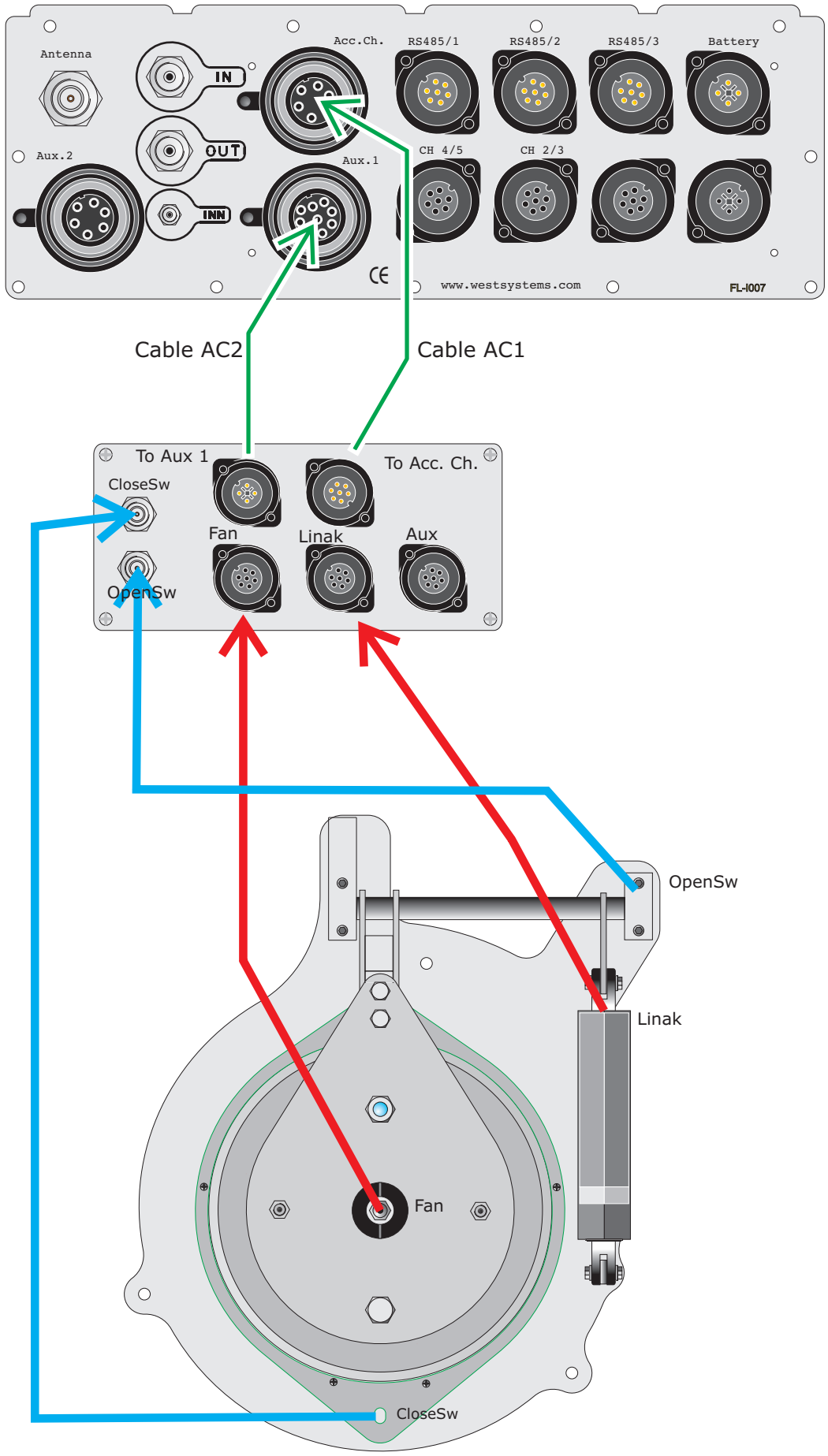
Soil.box

The Soil.Box, described in deep in the appendix S, is the new interface for the soil sensors..
A platinum 100 Ohm temperature probe and a Campbel Scientific CS616 Time Domain Reflectometer can be connected to the soil.box in order to measure the soil temperature and the soil water content.



On-Field Installation

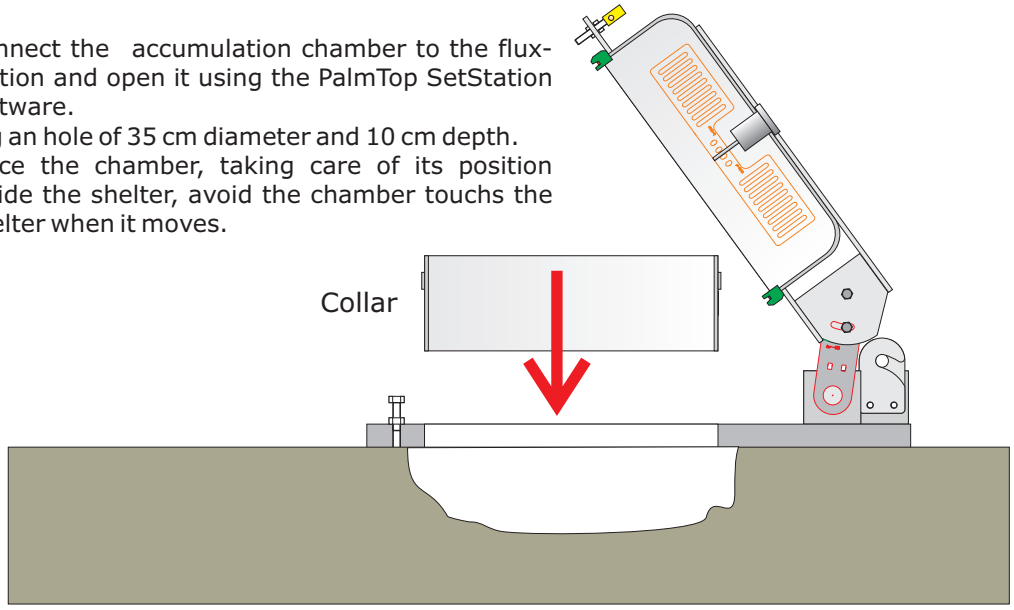
Accumulation chamber



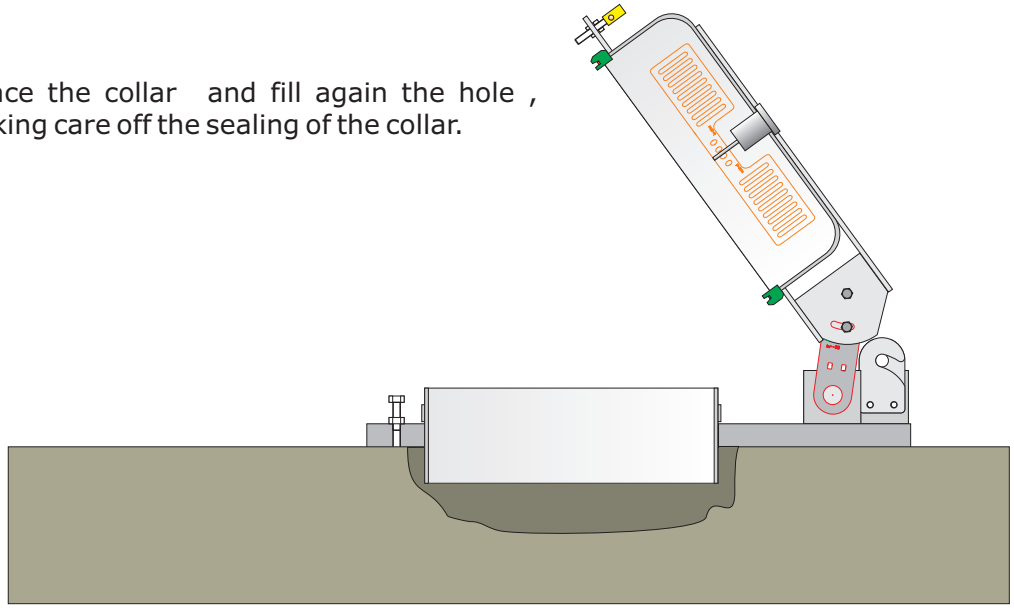
On-Field Installation

Accumulation chamber

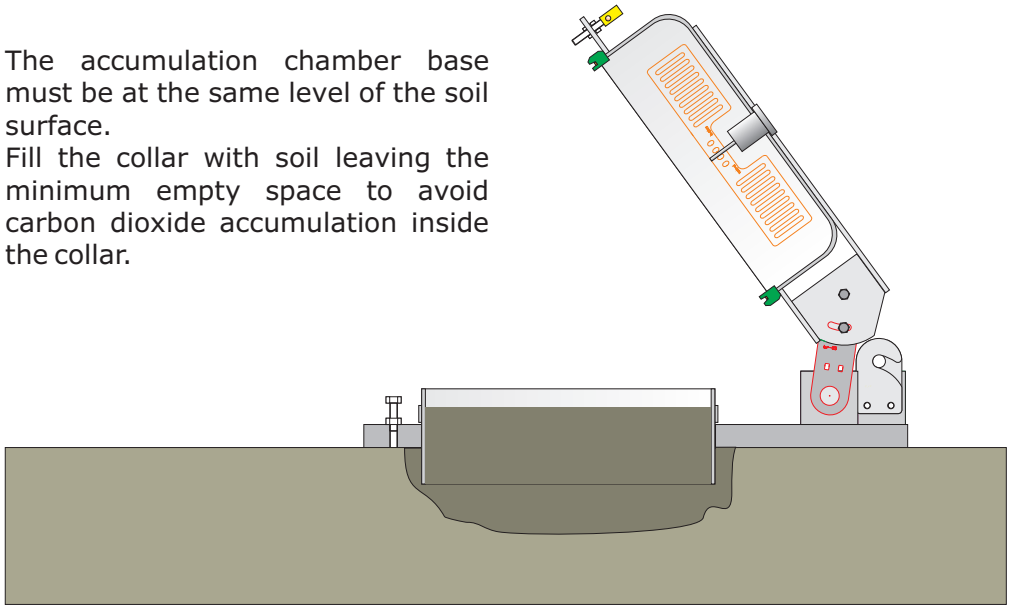
Connect the accumulation chamber to the flux-station and open it using the PalmTop SetStation software.
Dig an hole of 35 cm diameter and 10 cm depth.
Place the chamber, taking care of its position inside the shelter, avoid the chamber touchs the shelter when it moves.



Place the collar and fill again the hole , taking care off the sealing of the collar.

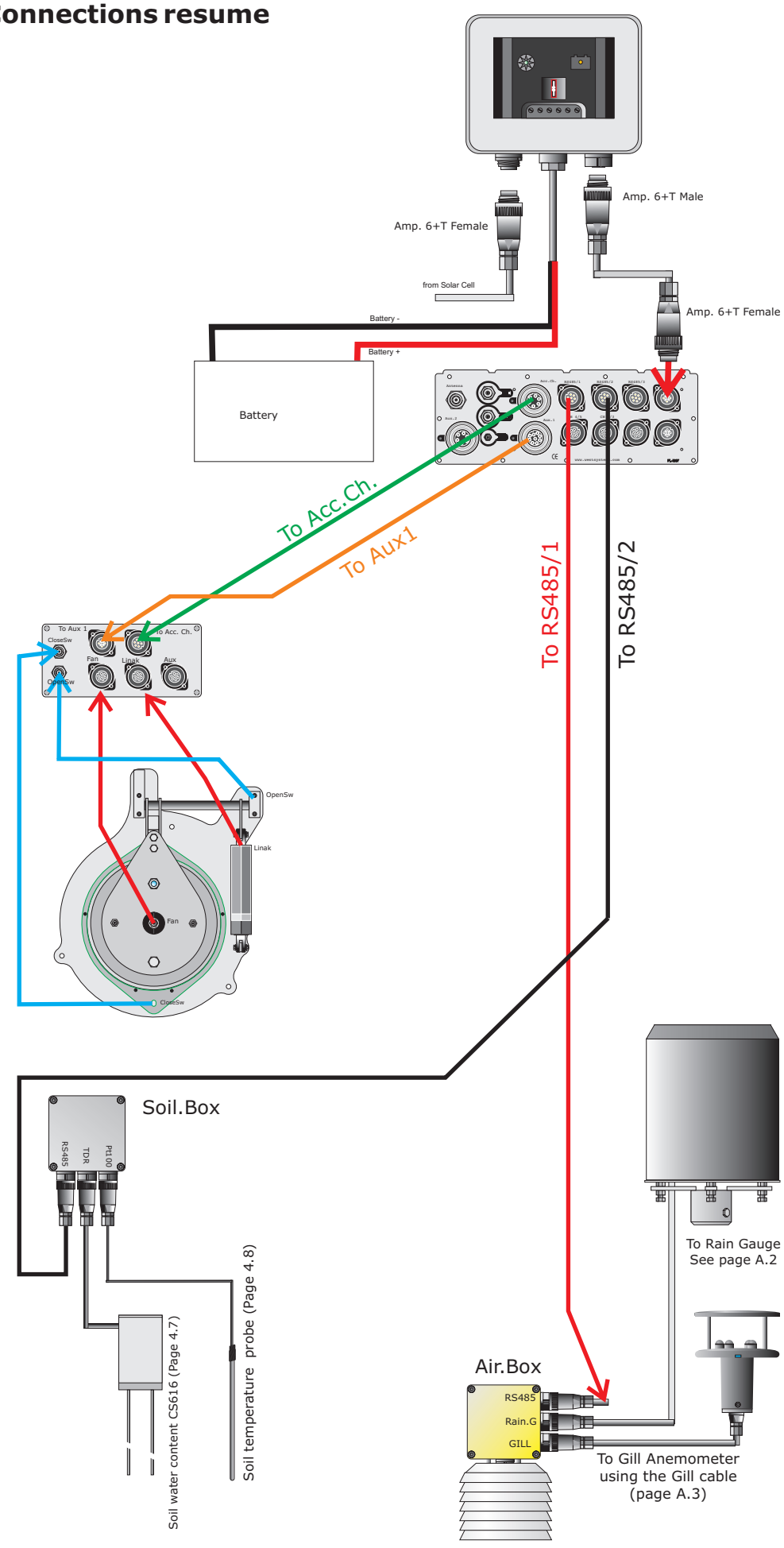


The accumulation chamber base must be at the same level of the soil surface.
Fill the collar with soil leaving the minimum empty space to avoid carbon dioxide accumulation inside the collar.



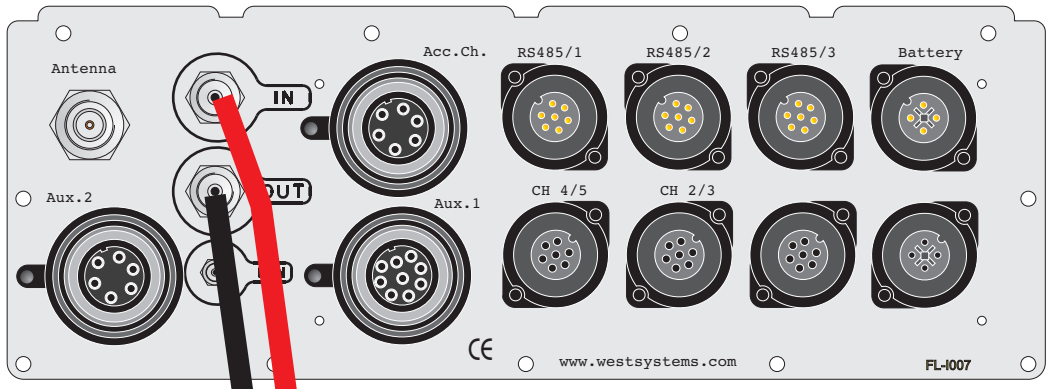
On-Field Installation

Connections resume



On-Field Installation

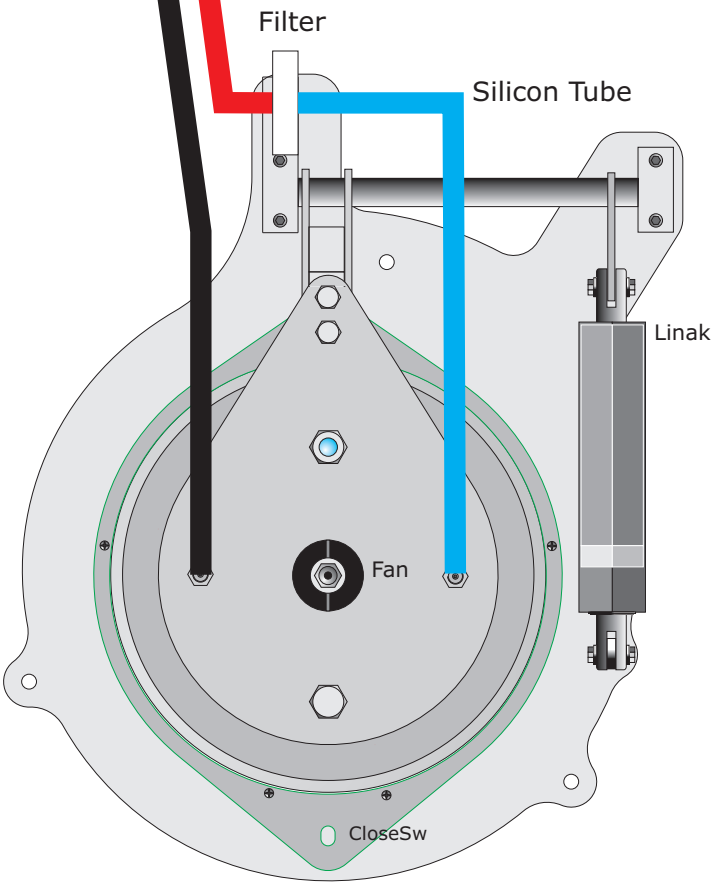
Accumulation chamber tubes



Red 6x4 Rilsan Tube

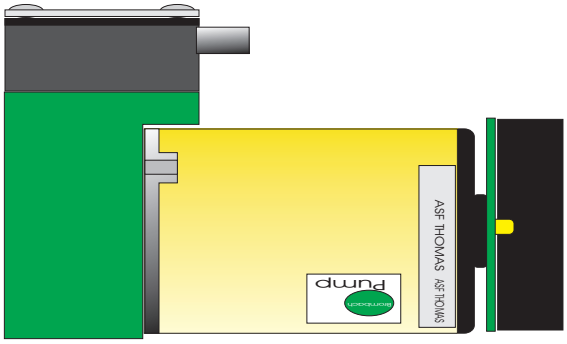
Connect the accumulation chamber to the FluxStation respecting the InLet / OutLet.
The InLet must be protected with the 2 inches filter mounted on the accumulation chambe base.

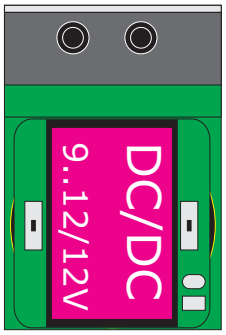
Black 6x4 Rilsan Tube

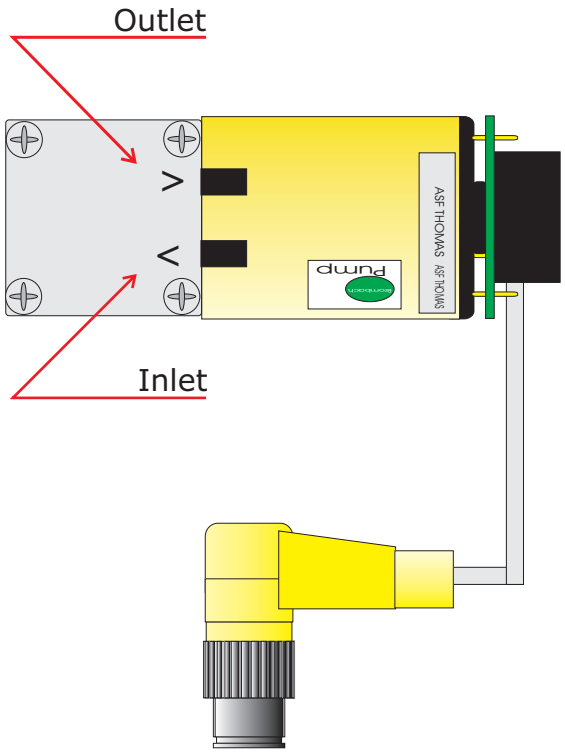


Pneumatic circuit

Pump







Pump connections

Pin	Color	Function
1	Brown	+12V
2	White	n.c.
3	Blue	n.c.
4	Black	Gnd

Pump specifications

Rated flow: 1000 SCCM (Standard cubic centimeter per minute)
Power supply 150 mA @ 12 Volts

Manufacturer KNF, WEST Germany
NMP830KNDC

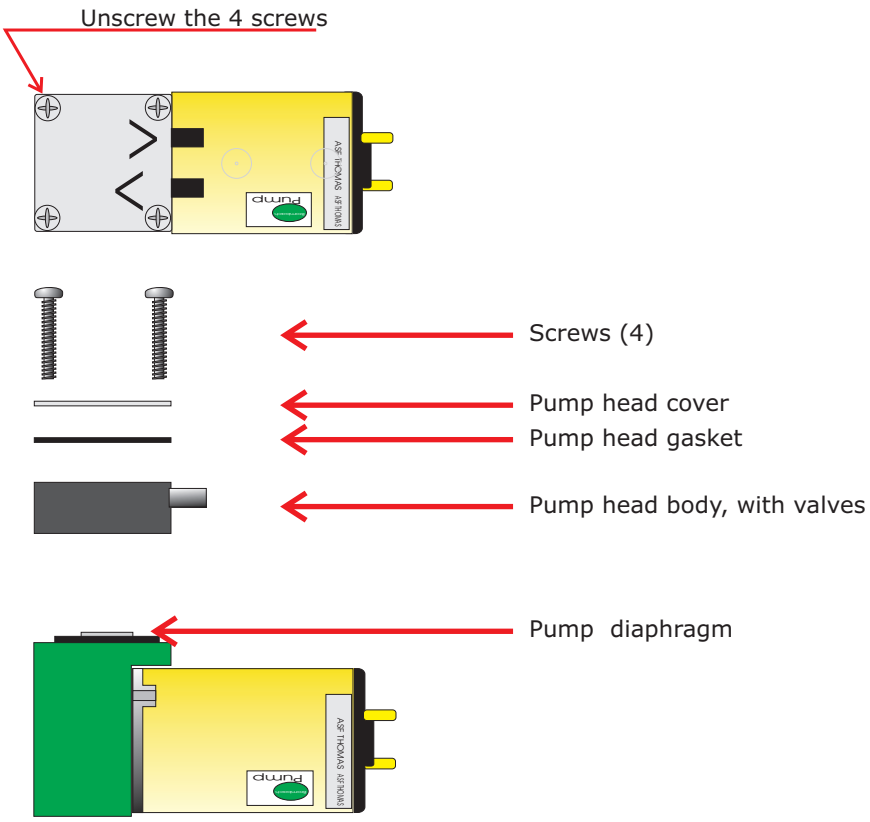
Pneumatic fittings diameter : 4 mm

Pneumatic circuit

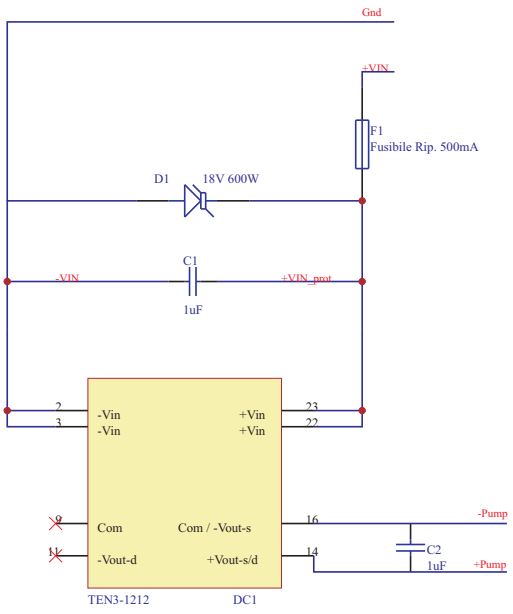
Pump maintenance

The pump efficiency can be affected by deposits of dust or water. When necessary it's possible to clean the pump:

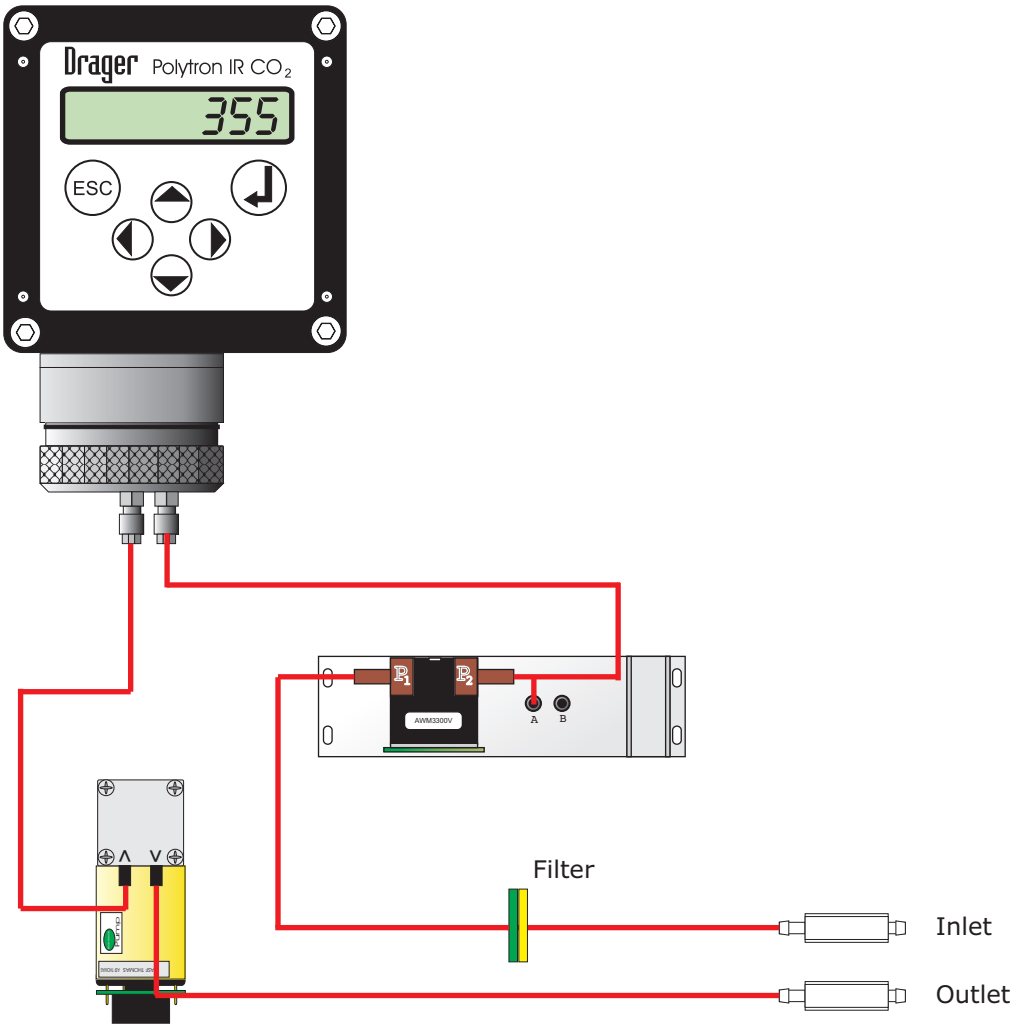
- Disassemble the pumping head
- Clean the diaphragm, the washer, and the valves using a compressed air flow.
- Reassemble the head.



Pump stabilizer scheme



Pneumatic circuit



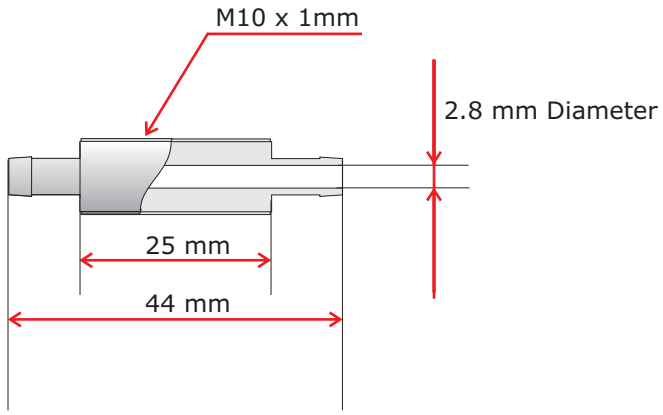
All the internal connections are made with silicon tube 8 mm external diameter 3.3 mm internal diameter;

To avoid problems on the reading of P.Flow, that can be affected by the new KNF pump efficiency, please adopt this schema in the pneumatic connections.

Pneumatic circuit

The fittings

WEST Systems Tube fitting for RILSAN 6x4 and Silicon tubes



Material : Chromed brass

The tubes

3 types of tube are used to realize the gas sampling line:

- RILSAN tube 6 mm external diameter 4 mm internal diameter;
- SILICON tube 8 mm external diameter 3.3 mm internal diameter;
- SILICON 12.5 mm external diameter 4.3 mm internal diameter.

The filters

Two types of filters are used to protect the gas sampling line:

- 25 mm diameter 0.22μm PTFE membrane Cole-Palmer 2915-20 or equivalent;
- 50 mm diameter 0.45μm PTFE membrane Cole-Palmer 2915-30 or equivalent.

The PTFE membrane filters are permeable to gases and water vapour and are impermeable to liquid water and dust particles. The use of the filters protects the gas detectors and the other pneumatic parts.
Please check the status of the filters every month.

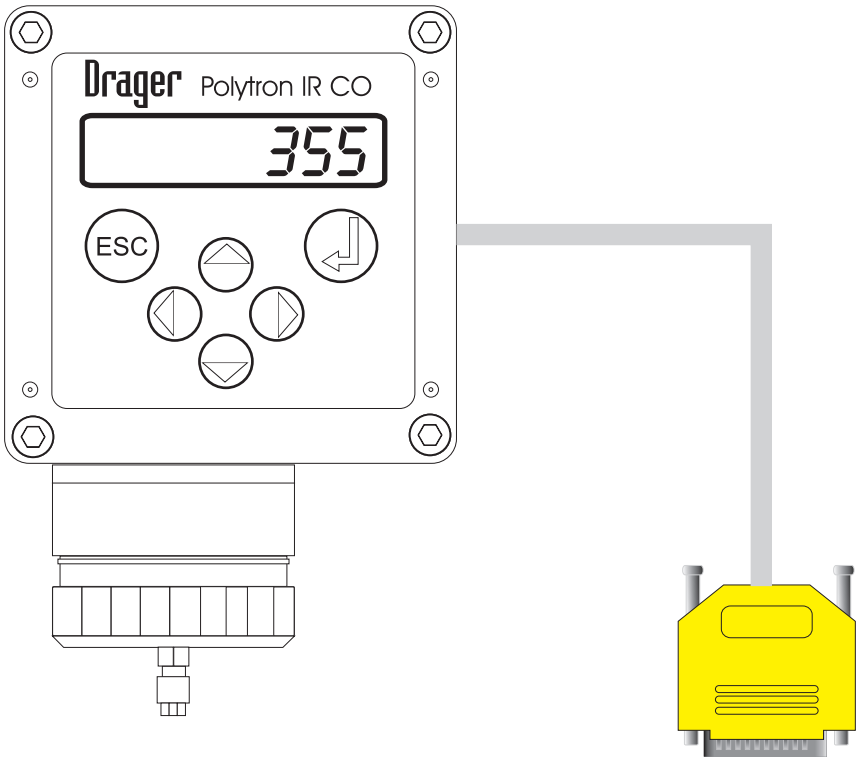
Sensors

Carbon dioxide detector

DRAGER Polytron IR CO_2 Specifications

Working principles: Double beam IR Detector with solid state sensor compensated in temperature, without moving parts.

- Full scale :Range 2000 ppm ~ 100% configurable by the operator.
- Accuracy 3% of reading for > 350 ppm
- Signal noise: 1% of reading pk-pk noise Out 4~20 mA linearized.
- IP63 Case with anti spray protection IP65.
- Operating temperature : between -20 and +65 °C.
- Air relative humidity 0~95%.
- Power supply 14-24 Volt DC Typical 300mA @ 24V

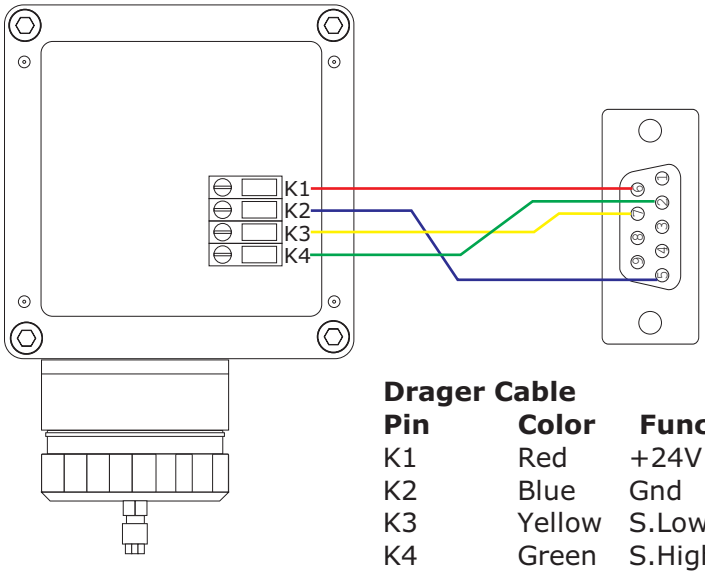


DB 9 Male : Ch.0

Channel	CO2
Ch. Name	CO2 ppm
Ch. number	0

Sensors

Carbon dioxide detector internal connections



Drager Cable

Pin	Color	Function	DB9 pin
K1	Red	+24V	9
K2	Blue	Gnd	5
K3	Yellow	S.Low	7
K4	Green	S.High	2

Carbon dioxide detector setup

For the setup of the correct full scale please refer to pages 56-57 of Polytron transmitter IR CO2 handbook and to page 3.4 of this manual.

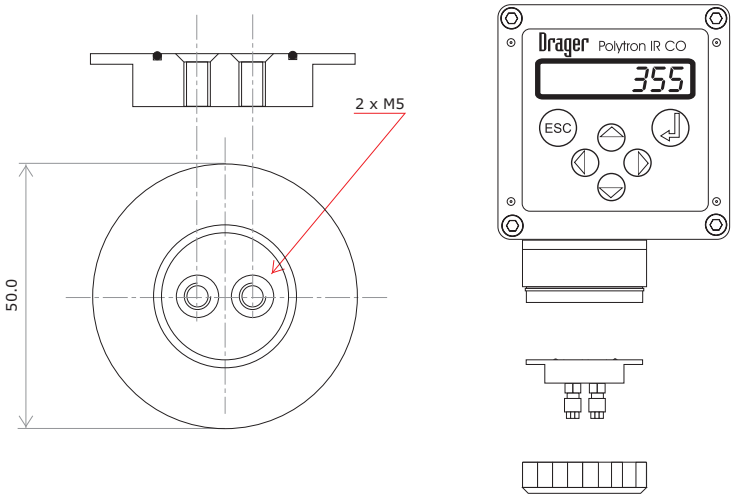
Carbon dioxide detector calibration

For the calibration of the detector please refer to pages 38-42 of Polytron transmitter IR CO2 handbook

Carbon dioxide detector 4-20 mA calibration

For the calibration of the 4-20mA interface please refer to pages 43-44 of Polytron transmitter IR CO2 handbook and to page 11.1 of this handbook.

Carbon dioxide detector pneumatic connections



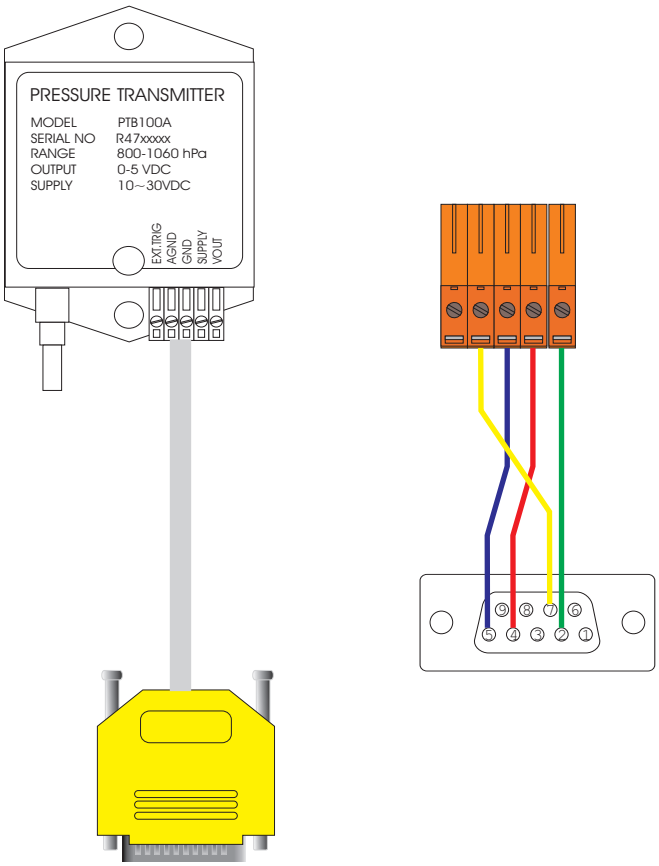
Drawing of the pipe - Drager interface.

Sensors

Barometric pressure gauge PT100B

Maximum working elevation 4000 meters
Manufatcurer : VAISALA
Ordering code :VAISALA-PT100B
Range 600-1060 HPa (mBar)
Accuracy 0.5 HPa
Outpu 0-5 Volt
Power supply 12 Volt Typical 4 mA @ 12 Volt

Channel	Barometric pressure
Ch. Name	B.Pr. HPa
CH. #	1



DB 9 Male : Ch.1

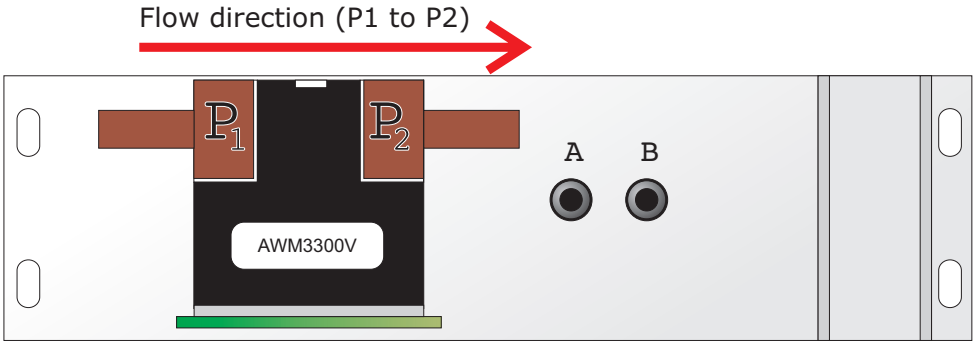
Vaisala Cable

Pin	Color	Function	DB9 pin
Supply	Red	+12V	4
Gnd	Blue	Gnd	5
AGnd	Yellow	S.Low	7
VOut	Green	S.High	2

Sensors

Gas line flow meter

Manufatcurer : WEST Systems
(Sensor made by Honeywell-SensorTechnics)
Ordering code :AWM3300
Gas flow
Range 0 to 1300 SCCM
Accuracy 2% of F.S.
Power supply 10 Volt Typical 30 mA @ 24 Volt



dP Channel
Manufatcurer : WEST Systems
(Sensor made by Honeywell-SensorTechnics)
Ordering code :AWM3300
Gas flow
Range 0 to 1300 SCCM
Accuracy 2% of F.S.
Power supply 10 Volt Typical 30 mA @ 24 Volt

P.flow and dP Channels
The P.Flow channel measures the gas flow in the sampling line. The value must be in the range 700-1450 SCCM.

The **dP** channel measures the depression of the pump. The value is affected by the filter status. Standard values are in the range 800-950 HPa. (When working at sea-level: Carometric pressure 1013 HPa). At these condition the P.Flow value has to be 800-1450 SCCM.

The **dP** down to 600-650 HPa when the filters are dirty. The P.Flow also decreases in these conditions.

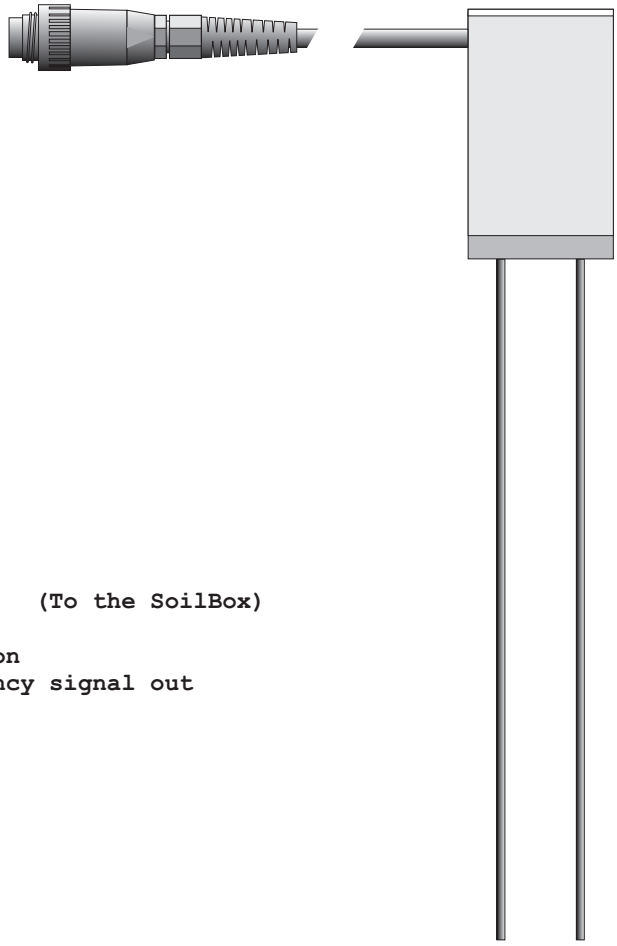
The **dP** grows up to the barometric pressure is the pump efficiency decreases. The P.Flow also decreases in these conditions.

Sensors

Soil water content

Manufatcurer : Campbell Scientific
Ordering code : . . . CS616 / CS615 (Out of stock)
Water content
Range 5-50 %
Accuracy 3%

The CS616 (CS615) Water Content Reflectometer measures the volumetric water content of porous media using time-domain measurement methods.
The Water Content Reflectometer consists of two stainless steel rods connected to a printed circuit board. A shielded four-conductor cable is connected to the circuit board to supply power, enable the probe, and monitor the pulse output. The circuit board is encapsulated in epoxy. The probe rods can be inserted from the surface or the probe can be buried at any orientation to the surface.
The CS616 (CS615) response is dependent on the dielectric constant of the material surrounding the probe rods. Water is the principal contributor to the dielectric constant value, but the solid constituents such as quartz, clay and organic matter also affect the measurement. The same calibration of volumetric water content to probe output signal period may not apply to all soils. Accuracy can be optimized by using calibrations derived for a specific soil. Accuracy of ± 2.0% over the entire water content range and for a wide range of soil types is routinely obtained in our laboratory. Applying the general calibrations from the operating manual provides accuracy of ± 3.0%.

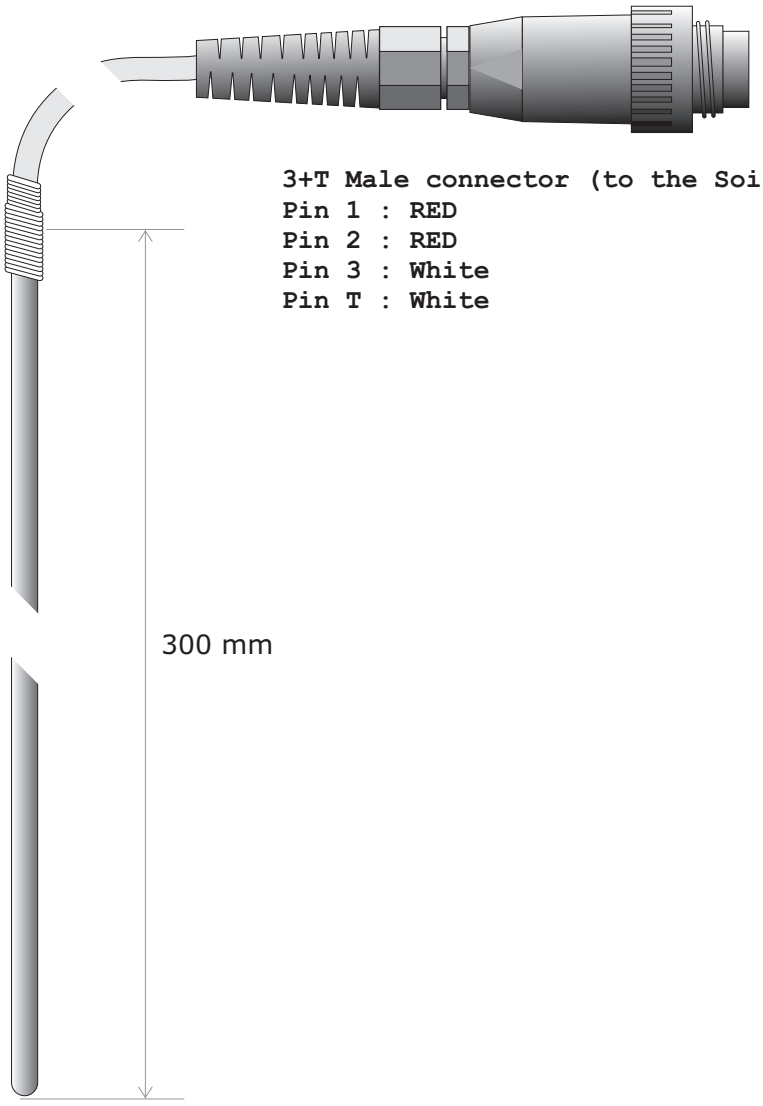


6+T Male cable connector (To the SoilBox)
Pin 1 : Red +12 Volt
Pin 2 : Orange Ignition
Pin 3 : Green Frequency signal out
Pin 4 : Black+Sh. Ground
Pin 5 : n.c.
Pin 6 : n.c.
Pin T : n.c.

Sensors

Soil temperature

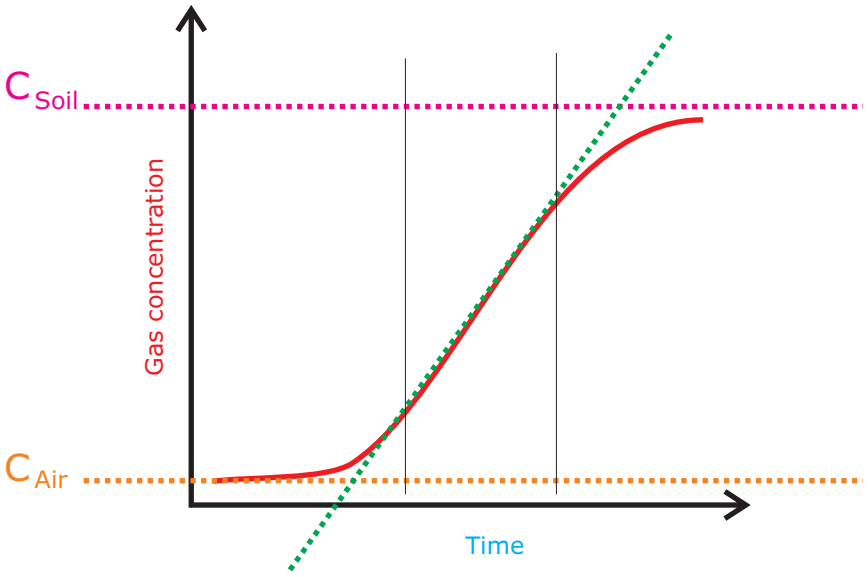
Manufatcurer : RS
Ordering code :RS 321-6090
Type : Pt100 DIN IEC 751 Class B 4 wires
Range 0 to 200 °C
Max operating temperature 200°C
Accuracy 0.3°C
Probe length 300 mm
Probe diameter 6 mm
Cable length 3 Meter
Cable PTFE and silicon insulated



The meteorological sensors are described in the Appendix A.

The accumulation chamber

The flux is proportional to the concentration increase ratio ppm/sec. The proportionality factor depends on the chamber volume/surface ratio as well as the barometric pressure and the air temperature inside the accumulation chamber.



The station, in the default configuration record and store the barometric pressure, the air temperature and the soil temperature.
The variation of few degrees of temperature do not affect the evaluation of flux very much, then it's possible to use the air temperature instead of the temperature of the gas mixture into the accumulation chamber.
The instrument measures the barometric pressure, using the VAISALA barometric pressure gauge, with a good accuracy. A platinum Pt100 it's used to measure the soil temperature and a digital solid state based device measure the air temperature.

Choosing the flux measurement unit

The first measurements made, 10 years ago, with the accumulation chamber was expressed in cm/sec which is a speed, the speed of carbon dioxide flowing out from the soil. During the last ten years several units have been used by volcanologist and by geochemistry researchers. The most common unit is grams/squaremeter per day, but using the same instrument for two gas species to express the flux using this unit means to have two different conversion factors. Actually we use the unit **moles/squaremeter per day** that has two advantages: A single conversion factor for every gas specie and an easy conversion of the flux in grams/sm per day simply multiplying the result expressed in moles/sm per day for the molecular weight of the target gas.

The Scada-suite the flux using the unit "moles/mq/day"

The accumulation chamber

The accumulation chamber factors

Here following the formula used to compute the A.c.K.:

$$K = \frac{86400 \cdot P}{10^6 \cdot R \cdot T_k} \cdot \frac{V}{A}$$

Where

- **P** is the barometric pressure expressed in mBar (HPa)
- **R** is the gas constant 0.08314510 bar L K^{-1} mol^{-1}
- **T_k** is the air temperature expressed in Kelvin degree
- **V** is the chamber net volume in cubic meters
- **A** is the chamber inlet net area in square meters.

The dimensions of the A.c.K. are

$$K = \frac{moles \cdot meter^{-2} \cdot day^{-1}}{ppm \cdot sec^{-1}}$$

In the table the conversion factors vs temperaure and barometric pressure for the Accumulation Chamber Type A and B are reported.

An example:

If the slope of the flux curve is 2.5 ppm/sec, the barometric pressure is 1011 mBar (HPa) and the air temperature is 23 °C.
From the table (Page 5.7) get the value that correspond to the barometric pressure and temperature. In this case I get the value computed for 25°C and 1013 mBar : 0.440

Then the flux is: 2.5 x 0.440 = 1.10 moles per square meter per day.

The accumulation chamber

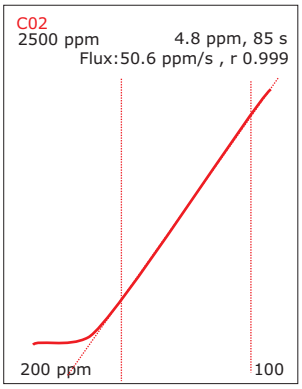
In the following table the factors for the conversion from ppm/sec slope to moles m^{-2} day^{-1} are reported

Bar. Pressure	Air.T. °C									
Hpa (mbar)	-10	-5	0	5	10	15	20	25	30	35
1013	0.499	0.489	0.480	0.472	0.463	0.455	0.448	0.440	0.433	0.426
983	0.484	0.475	0.466	0.458	0.450	0.442	0.435	0.427	0.420	0.413
955	0.470	0.461	0.453	0.445	0.437	0.429	0.422	0.415	0.408	0.401
927	0.456	0.448	0.440	0.432	0.424	0.417	0.410	0.403	0.396	0.390
900	0.443	0.435	0.427	0.419	0.412	0.404	0.398	0.391	0.384	0.378
873	0.430	0.422	0.414	0.407	0.400	0.393	0.386	0.379	0.373	0.367
848	0.417	0.410	0.402	0.395	0.388	0.381	0.375	0.368	0.362	0.356
823	0.405	0.398	0.390	0.383	0.377	0.370	0.364	0.358	0.352	0.346
799	0.393	0.386	0.379	0.372	0.366	0.359	0.353	0.347	0.341	0.336
776	0.382	0.375	0.368	0.361	0.355	0.349	0.343	0.337	0.331	0.326
753	0.371	0.364	0.357	0.351	0.345	0.339	0.333	0.327	0.322	0.317
731	0.360	0.353	0.347	0.340	0.334	0.329	0.323	0.318	0.312	0.307
710	0.349	0.343	0.337	0.331	0.325	0.319	0.314	0.308	0.303	0.298
689	0.339	0.333	0.327	0.321	0.315	0.310	0.304	0.299	0.294	0.290
669	0.329	0.323	0.317	0.312	0.306	0.301	0.296	0.291	0.286	0.281
649	0.320	0.314	0.308	0.302	0.297	0.292	0.287	0.282	0.277	0.273
630	0.310	0.305	0.299	0.294	0.288	0.283	0.279	0.274	0.269	0.265

In the following table the factors for the conversion from ppm/sec slope to grams m^{-2} day^{-1} are reported

Bar. Pressure	Air T. °C								
Hpa (mbar)	-10	-5	0	5	10	15	20	25	30
1013	21.94	21.53	21.14	20.76	20.39	20.04	19.70	19.37	19.05
983	21.30	20.90	20.52	20.15	19.80	19.45	19.12	18.80	18.49
955	20.68	20.29	19.92	19.56	19.22	18.88	18.56	18.25	17.95
927	20.07	19.70	19.34	18.99	18.66	18.33	18.02	17.72	17.43
900	19.49	19.12	18.77	18.44	18.11	17.80	17.49	17.20	16.92
873	18.92	18.57	18.23	17.90	17.58	17.28	16.98	16.70	16.42
848	18.37	18.02	17.69	17.38	17.07	16.77	16.49	16.21	15.94
823	17.83	17.50	17.18	16.87	16.57	16.28	16.00	15.74	15.48
799	17.31	16.99	16.67	16.37	16.09	15.81	15.54	15.28	15.02
776	16.80	16.49	16.19	15.90	15.62	15.34	15.08	14.83	14.59
753	16.31	16.01	15.71	15.43	15.16	14.90	14.64	14.40	14.16
731	15.84	15.54	15.26	14.98	14.72	14.46	14.21	13.98	13.75
710	15.37	15.09	14.81	14.54	14.29	14.04	13.80	13.57	13.34
689	14.92	14.65	14.38	14.12	13.87	13.63	13.40	13.17	12.95
669	14.49	14.22	13.96	13.71	13.46	13.23	13.01	12.79	12.58
649	14.06	13.80	13.55	13.31	13.07	12.84	12.63	12.41	12.21
630	13.65	13.40	13.15	12.92	12.69	12.47	12.26	12.05	11.85

The accumulation chamber

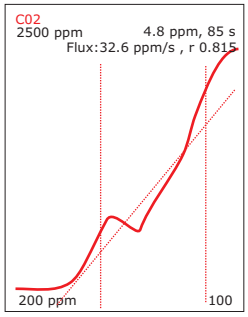


The "perfect" curve

In the figure on the left the display of palmtop during a flux mesurement is shown.

For clearness only the CO2 flux curve is shown.
The shape of the curve is quite perfect and the computation of the flux is done with a very good accuracy: **r** (regression quality factor) very close to 1.

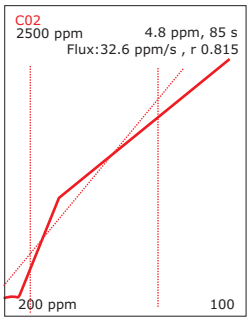
In the following figures some examples of strange shape flux curves:



Air contamination

The flux curve is no longer "linear", the linear best fit curve do not fit exactly the flux curve as pointed out by the regression quality factor (0.815 in the example). This effect is probably due to atmospheric air contamination.

If you obtain this kind of curve check the sealing of the accumulation chamber with the soil or check that tubes, filters and pump are intact.

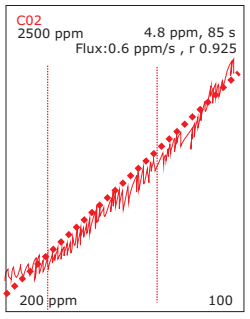


Gas stratification

This shape of curve indicates that the concentration of the target in air, close to the soil, is very high. This stratification is quite common in case of very high flux combined with a very stable atmosphere.

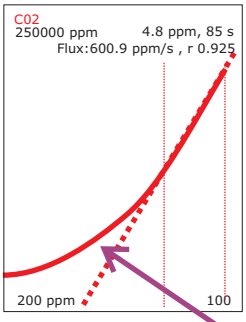
In this case clean the gas line making a measure in air, one meter above the soil surface, and afterwards repeat the flux measurement.

You can use the measurement choosing the second part of the curve for regression computation.



Low fluxes

This type of curve is normal when the flux is low and the "noise" of the detector is comparable with the increase of concentration.



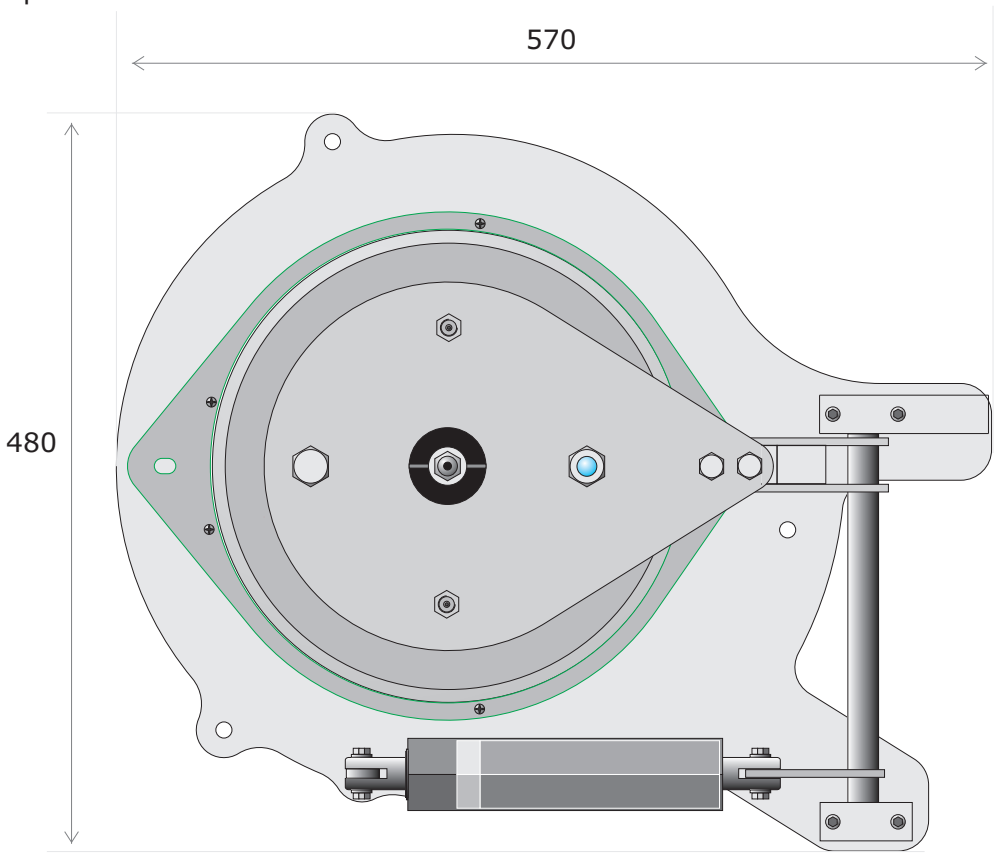
Very high flux

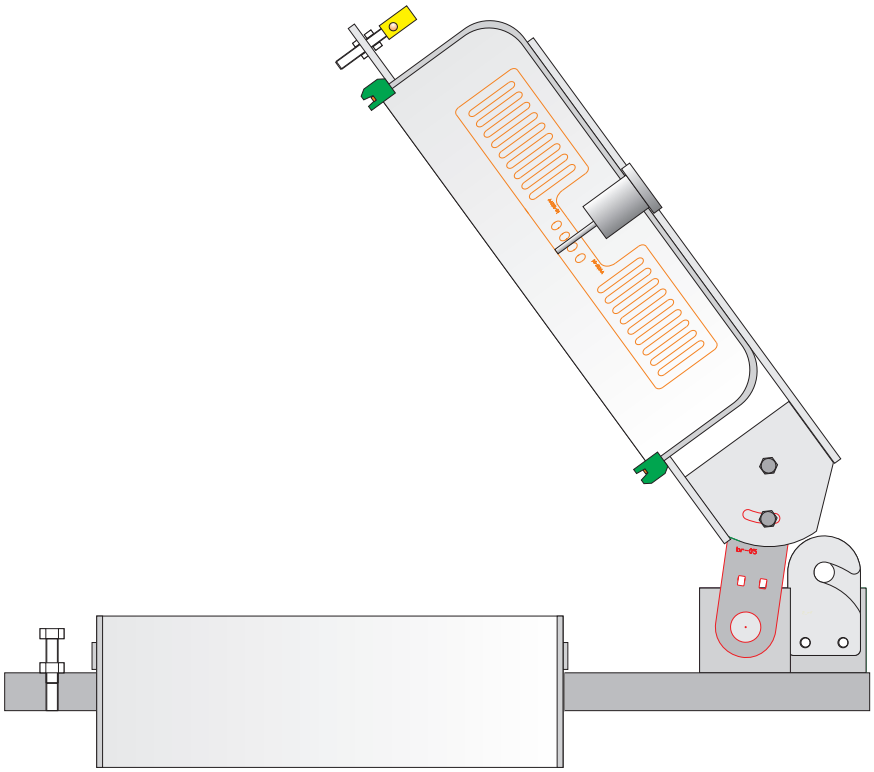
The first part of the curve is not linear. The problem is due to the combined effect of the high flux and the sampling line cleaning. To avoid this increase the flux curve record time until the concentration of gas reachs the full scale value and select the last part of the curve for the flux computation.

This effect is due to the cleaning of the sampling line dead volumes

The accumulation chamber

Foot print size





The accumulation chamber

Cable AC1

Bulgin 6 pin male — Amph 6+T pin female

Cable AC1

Bulgin Pin	Color	Amph Pin
1	Black	1
2	White	2
3	Blue	3
4	Yellow	4
5	Red	5
6	Brown	6

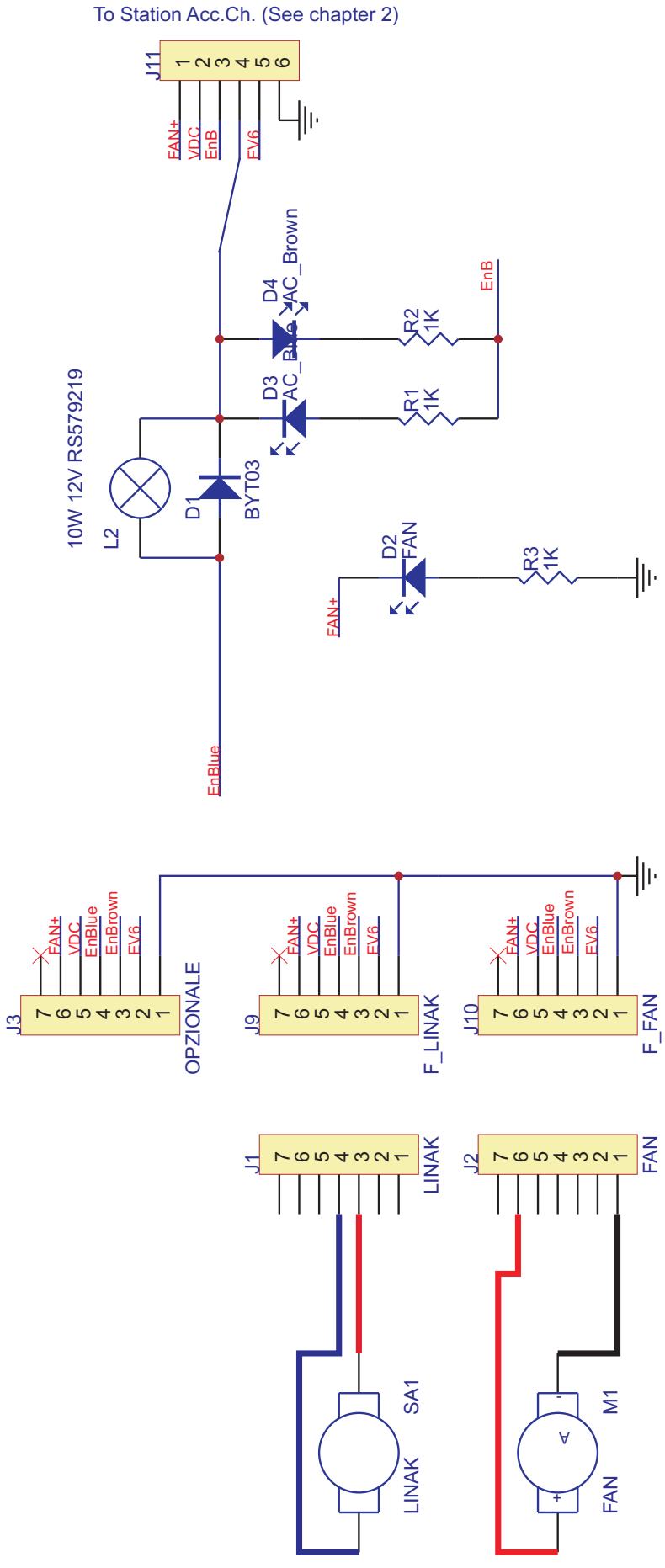
Cable AC2

Bulgin 9 pin male — Amph 3+T pin female

Cable AC2

Bulgin Pin	Color	Amph Pin
1	Red	1
2	Blue	2
3	n.c.	
4	n.c	
7	n.c	
8	Green	T
9	Yellow	3

The accumulation chamber

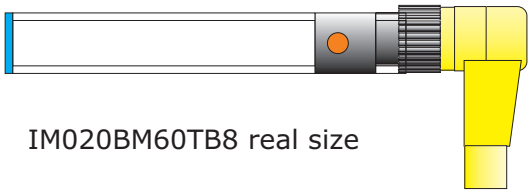


The accumulation chamber

Two proximity switches control the full opening and full closing of the accumulation chamber.

Type: inductive proximity;
Model: IM020BM60TB8
Range: 2mm- Shielded;
Protection grade: IP67;
Made by Wenglor
Thread: M8

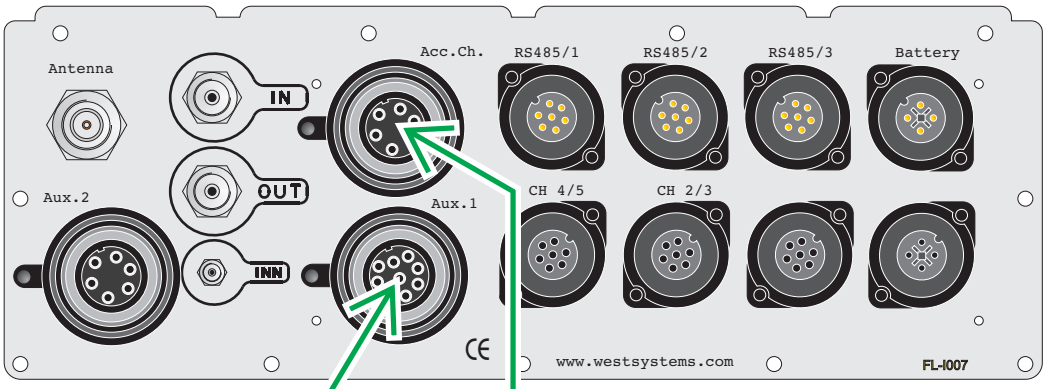
LED Light - On/Off



IM020BM60TB8 real size

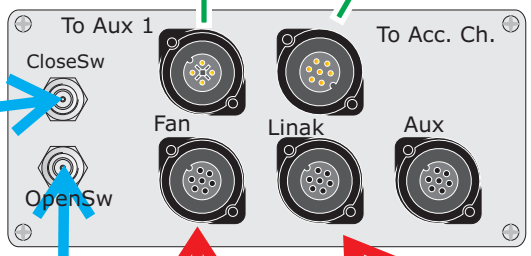
Cables:
Type: Nano change;
Part #:403001I03M020
Brand: Brad Harrison

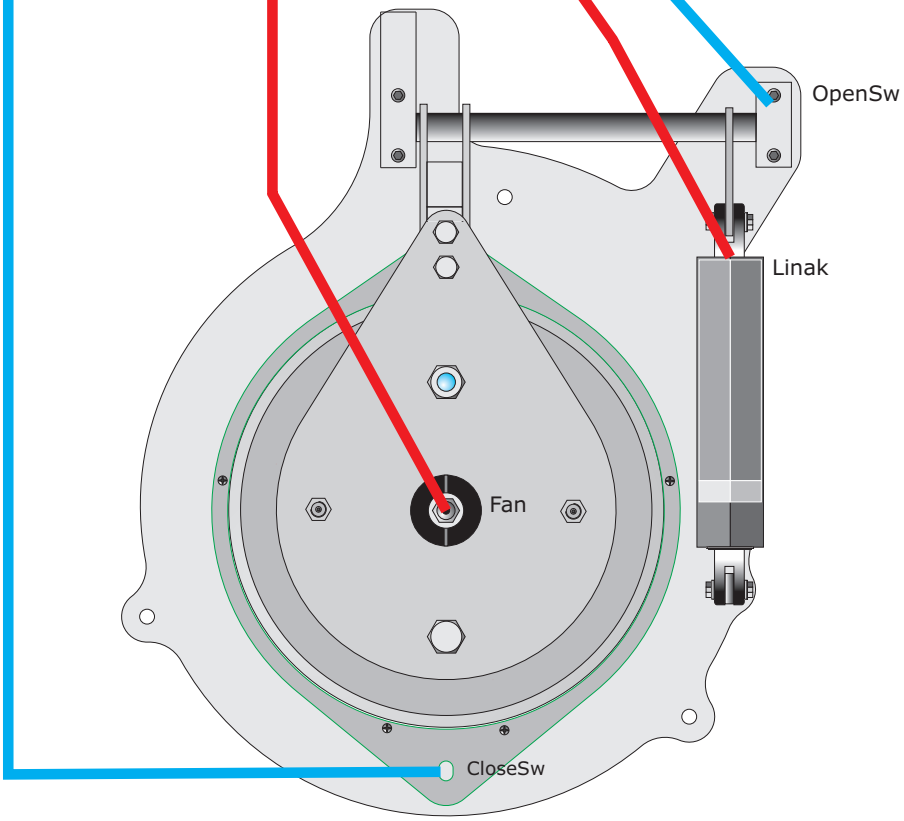
The accumulation chamber



Cable AC2

Cable AC1





Flux Station configuration/testing

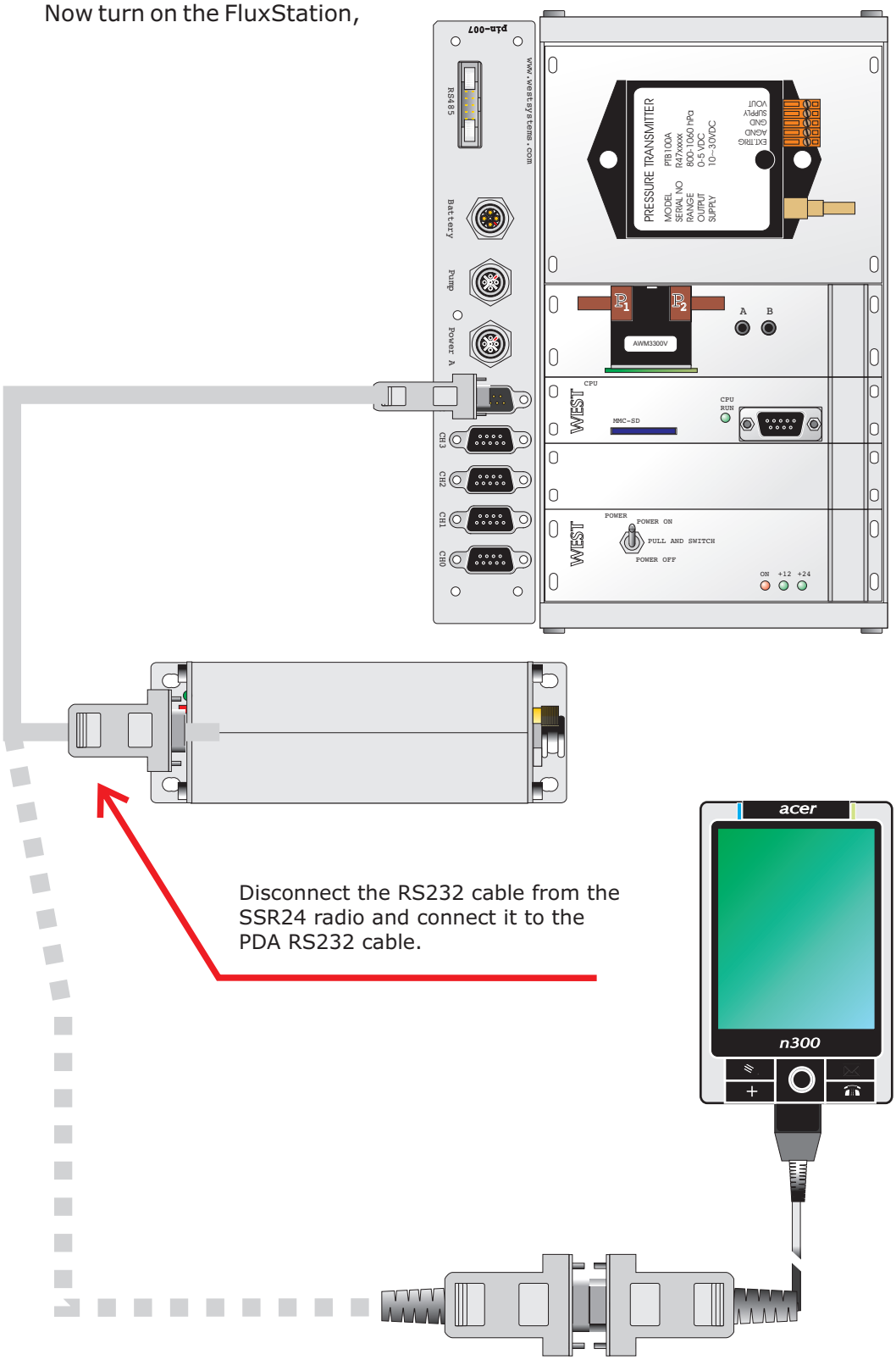
Palmtop (PDA) SetStation application

Run SetStation on the PDA, and connect the PDA to the station following the instruction below.

Verify that the station is in stand.by mode (+12V and +24V led light off) , else wait that the station finished the analisys cicle, then turn it off.

Disconnect the RS232 cable from the SSR24 radio and connect it to the palmtop;

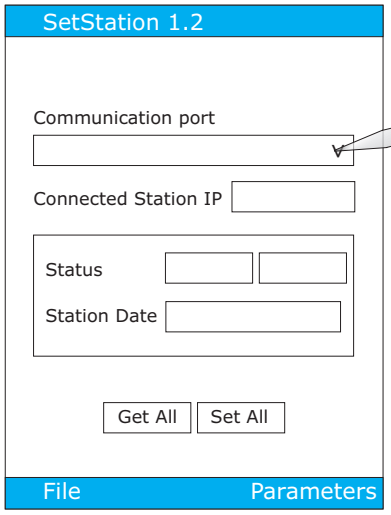
Now turn on the FluxStation,



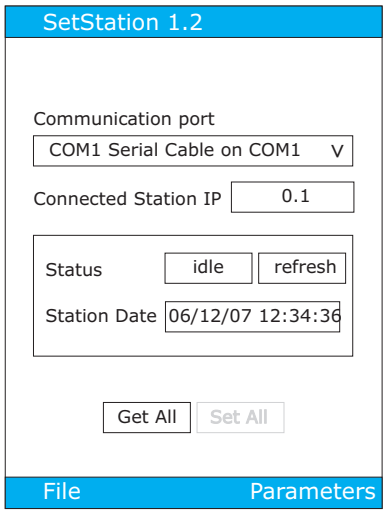
Flux Station configuration/testing

Palmtop (PDA) SetStation application

Run SetStation on the PDA (Installation instruction on Appendix Z)



Select :
COM1 Serial Cable on COM1



If the communication is successful the information on the screen will be updated.

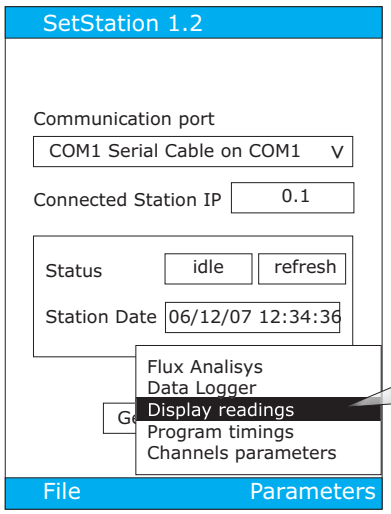
Status: **Idle** when the station is in StandBy / **running** when the station is performing a mesurement clicle;

Station IP is the address of the station **Default 0.1**;

Station Date is the actual value of the Date/Time clock of station.

By pressing Refresh button the clock and status information will be updated.

Get All will download all setting parameters from the station to PDA.

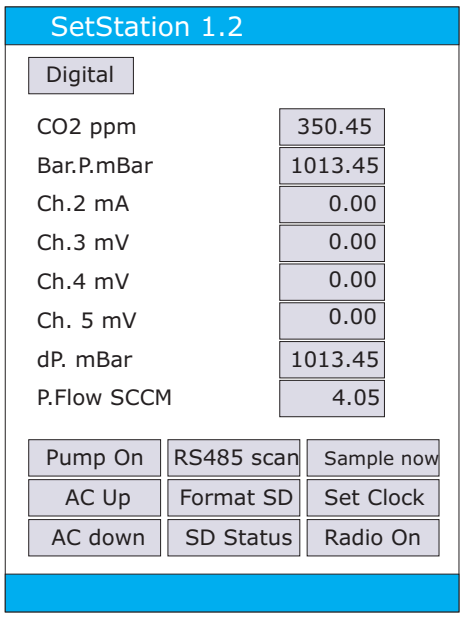


Checking and immediate actions

Select the {Parameters}{Display readings} menu voice.

Flux Station configuration/testing

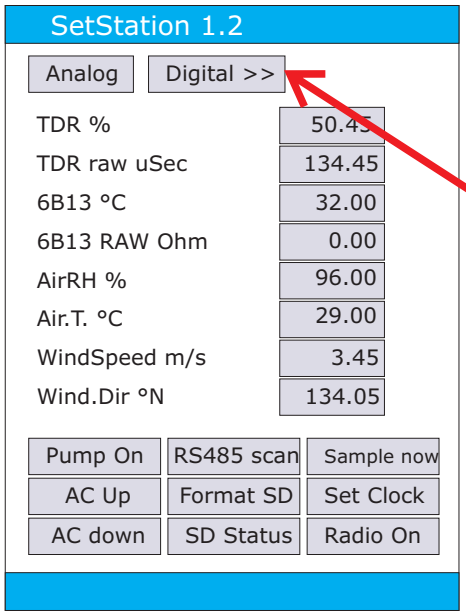
Display readings form



Now the infromation of the analogical channels is displayed.

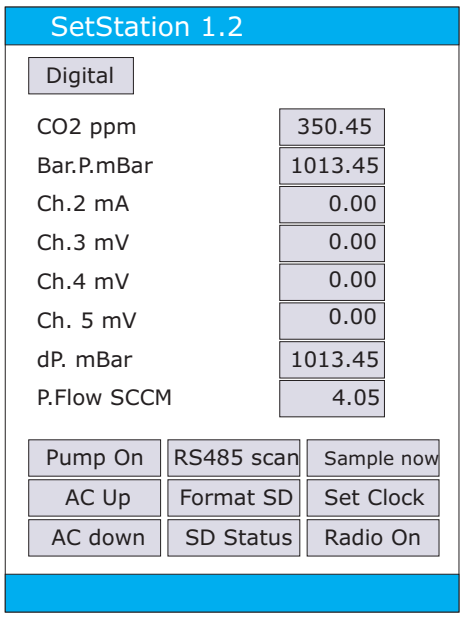
The readings are updated every second;

By pressing [Digital] button the information of digital channels is displayed..



The readings are updated every second;

If the list of digital sensors can't fit in a single page a cursor will appear to list the missing channels.



Immediate actions

By pressing [Pump On] button the pump will be activated. It will be on up to [Pump Off] button is pressed.

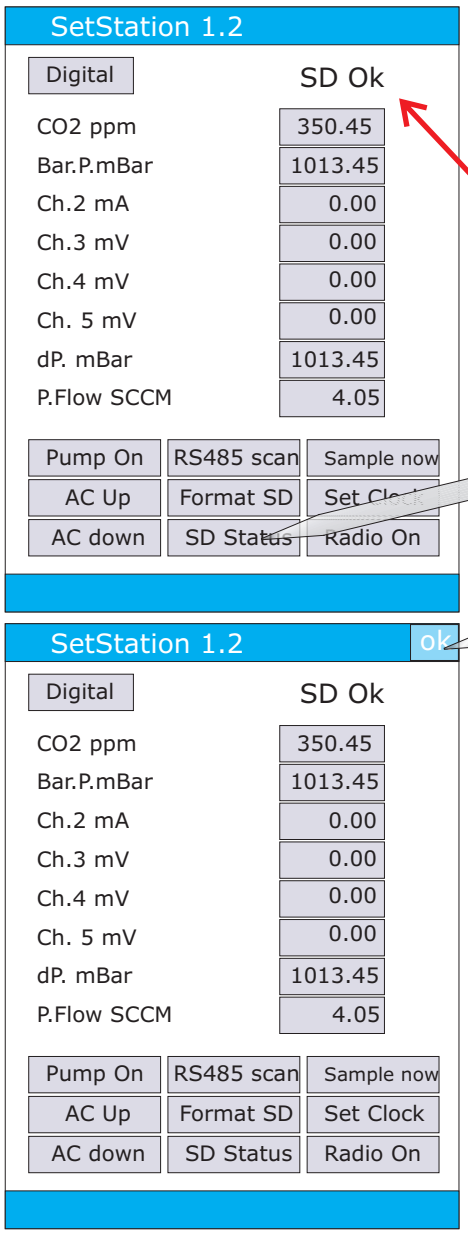
Same considerations for the other commands , except the AC Up / AC Down , where a time out will stop the action after a while. (To protect the AC motor);

By pressing [Set Clock] the FluxStation clock will be updated using the clock information of PDA.

By pressing [RS485 Scan] the list of digital sensors connected to the station will be updated. Perform this action if you added a new digital sensor, as Soil.Box and Air.Box;

Flux Station configuration/testing

Display readings form



SD memory card commands.

By pressing [Format SD] button the SD card will be formatted, loosing all the data stored on the card.

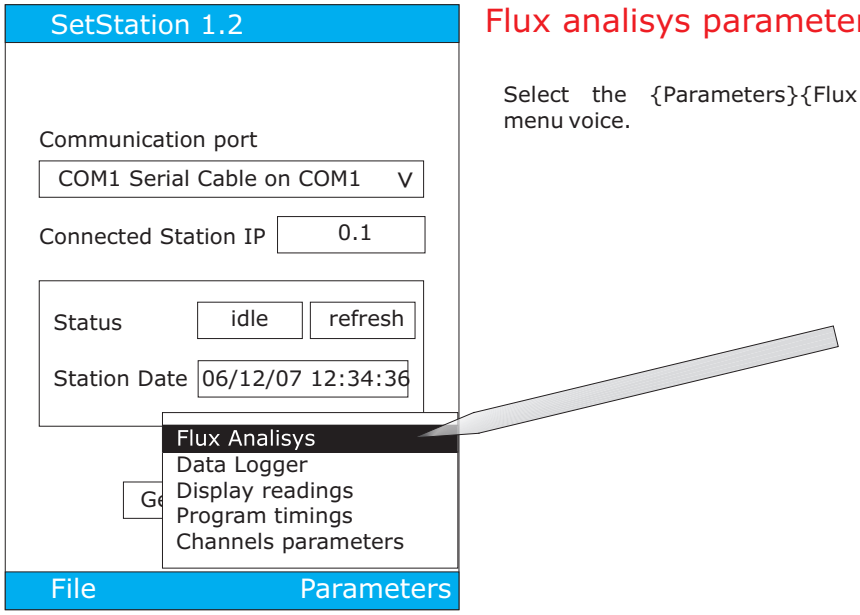
By pressing [SD Status] an short report about the SD card appear;

The "SD Card Ok" means that the station found the SD card and that's working fine.

Press OK to go back to main form .

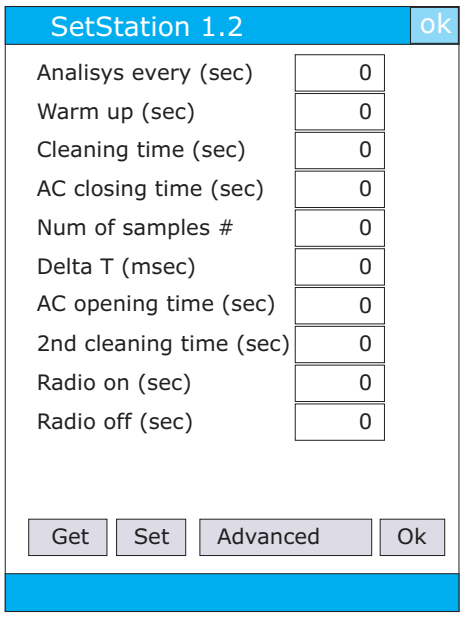
Flux Station configuration/testing

Palmtop (PDA) SetStation application

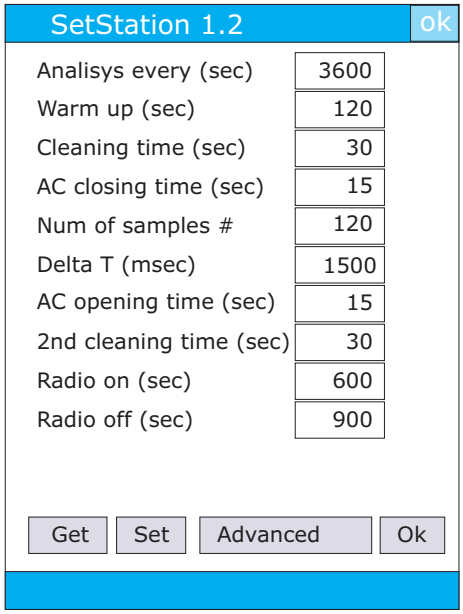


Flux analisys parameters

Select the {Parameters}{Flux analisys} menu voice.



When the form appear press [Get] to download the data for FluxStation. Modify, is necessary, the parameters and press [Set]. The [Advanced] menu is reserved for advanced programming of FluxStation when not standard actions are necessary. The advanced programming is quite complicate and not adviceable.

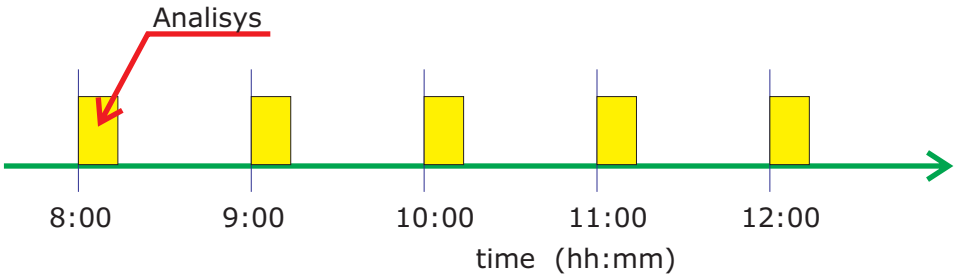


See next pages to understand the parameters meaning.

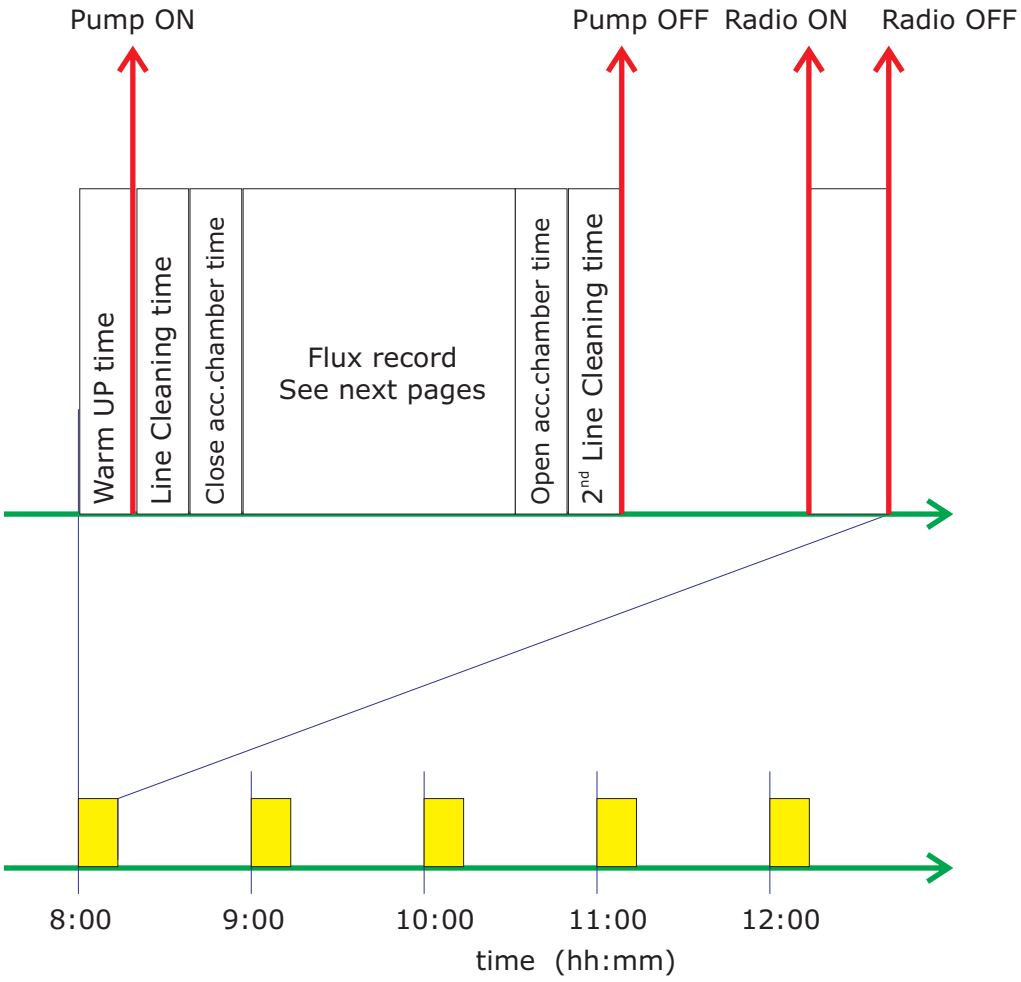
Flux Station configuration/testing

Palmtop (PDA) SetStation application

Analisys every time It's the interval between analisys. Normally the station makes an analisys every hour and then the default value of the parameter is 3600 sec;
Valid range 300 .. 7200 seconds;
If the time between analisys is 3600 secs (1 hour) the analisys will start exactly at the beginning of hour, for instance the sampling time will be 8 sharp, 9 sharp ect.



Every measurement cicle (analisys) is composed by several actions that are scheduled by some parameters described below.



Flux Station configuration/testing

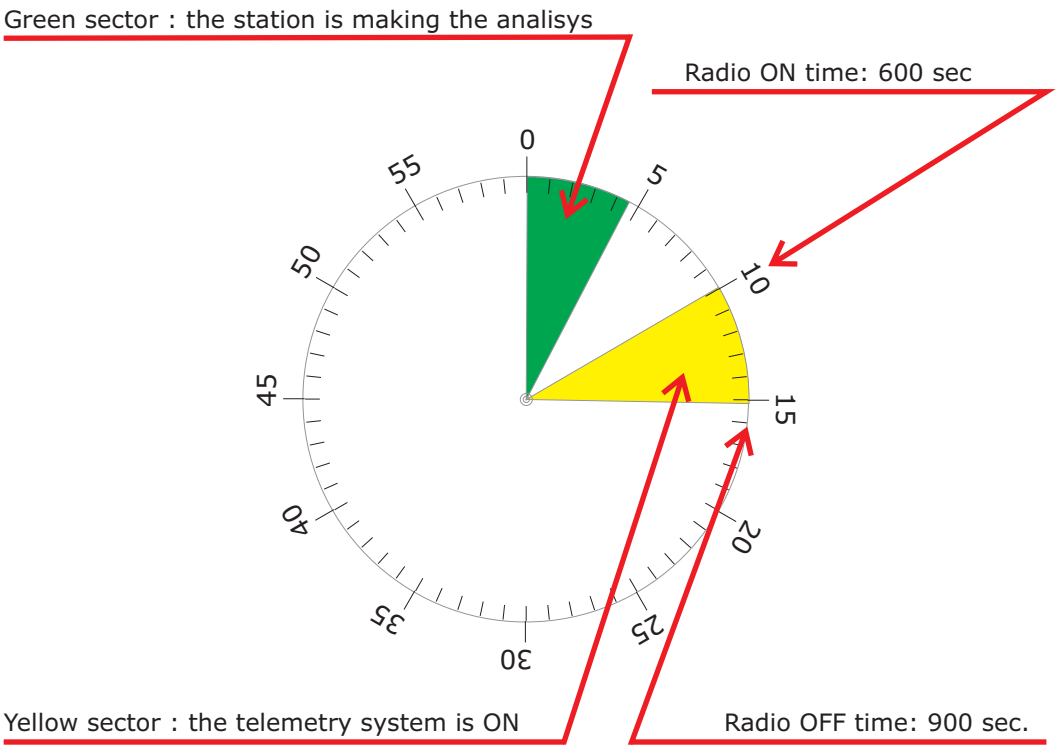
Palmtop (PDA) SetStation application

Set RADIO On/OFF:

In order to reduce the power consuption the telemetry system is managed as follow:

RADIO On time (sec)
The telemetry system will be turned ON after every analisys starting from the time,expressed in minutes, you set.

RADIO Off time (sec)
The telemetry system will be turned OFF after every analisys starting from the time,expressed in minutes, you set.



In the drawing a example of
Radio On time = 600 (sec)
Radio Off time = 900 (sec)

Flux Station configuration/testing

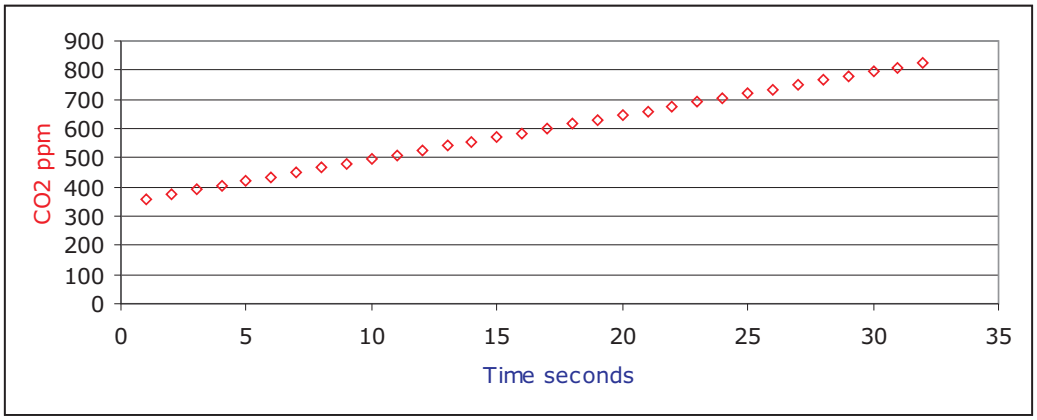
Palmtop (PDA) SetStation application

Num. Samples: Is the number of points in the flux record. Normally the value is between 32 and 256 points. The increase of this parameter will increase the size of the record, reducing the capability of station data storage and increasing the data transmission time.

Delta T.: Is the time , expressed in millisecond, between the points sampled in the flux record.
Normally the value is between 500 (0.5 seconds) and 3000 (3 seconds)

The global flux record time is : **Delta T. x Num. Samples/ 1000**

In the following plot a sample of flux record with Num of Samples = 32 and DeltaT. = 1000 (1 second). The overal flux record lenght is 32 second.

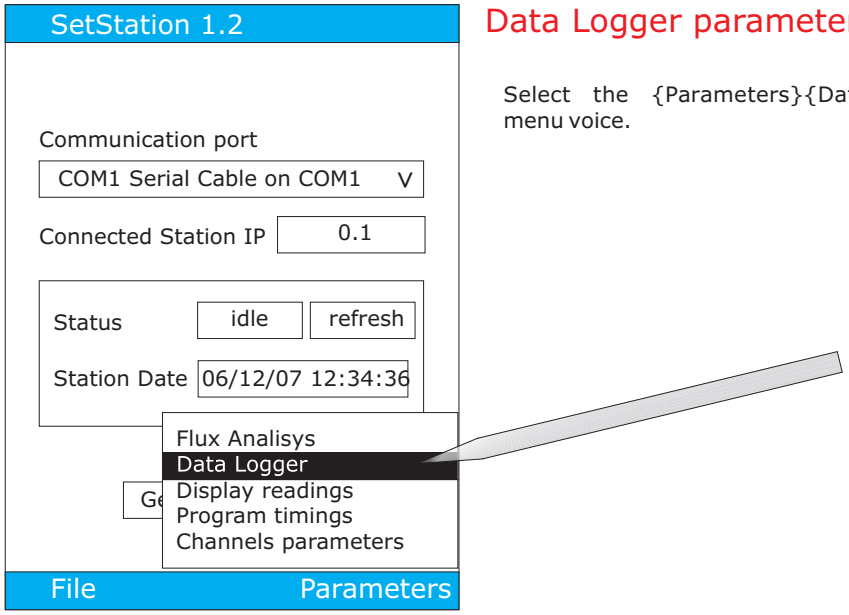


The normal record lenght must be in the interval 90 .. 240 seconds. If the flux is quite high the lenght can be 90 seconds, is the flux is quite low is better to increase the record lenght

Flux Station configuration/testing

Palmtop (PDA) SetStation application

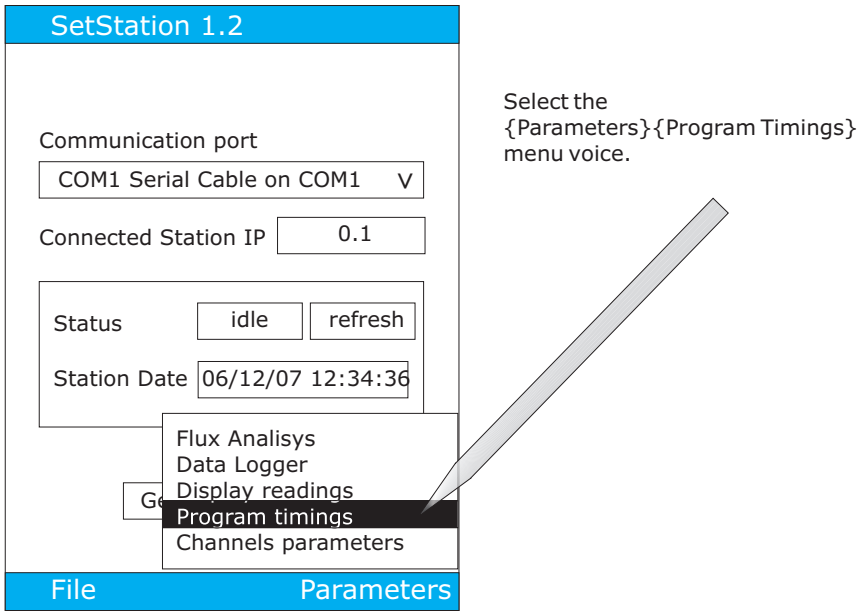
Data Logger parameters



Select the {Parameters}{Data Logger} menu voice.

The fluxstation can works as Data Logger, but in this modality it don't measure the flux, then this modality is not described here.

Program Timings



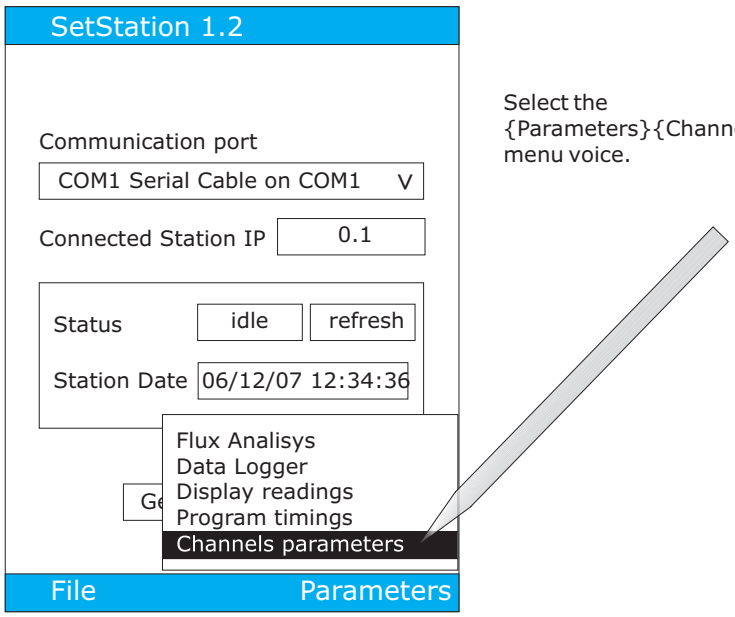
Select the {Parameters}{Program Timings} menu voice.

The Program Timings menu allow the modification of critical parameters of the station. In the normal use there is not necessity to access this form.

Flux Station configuration/testing

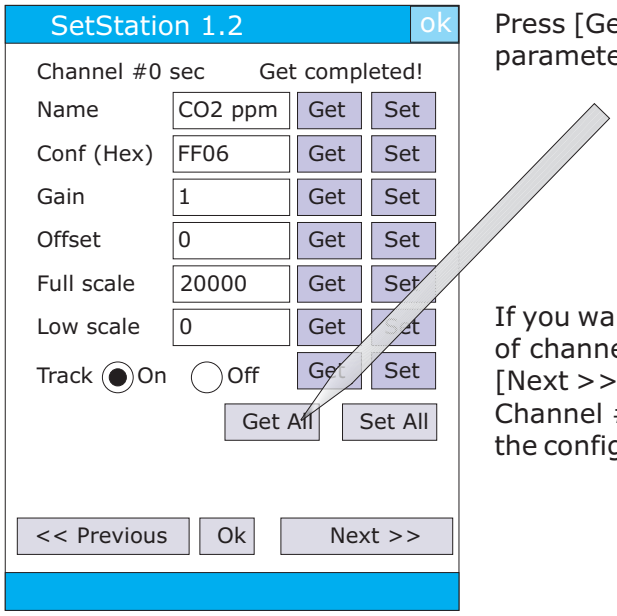
Channels parameters

Channels parameters



Select the {Parameters}{Channels Parameters} menu voice.

You've to access this menu when you've to change:
1) the full scale value of the DRAGER CO2 detector;
2) the analog channels configuration;
3) the number of flux curves.



Press [Get All] to read from station the parameters of the Channel 0

If you want to modify the configuration of channel 2 you've to press twice the [Next >>] button to access the page of Channel #2 then press [Get All] to get the configuration from fluxstation.

On the next page the discussion about the parameters of the channels.

Flux Station configuration/testing

Channels parameters

Name: is a description of the channel, to help the operator.

Conf: Is the type of channel, and it change the behaviour of the FluxStation. Valid Conf. are

FF06: the output of sensor connected to the channel is 4-20 mA and the fluxstation will consider 4mA equal to the "Low Scale" value and the 20 mA equal to the "Full Scale" value.

FF05: the output of sensor connected to the channel is 0-5V and the fluxstation will consider 0 V equal to the "Low Scale" value and the 5 V equal to the "Full Scale" value.

FF0F: special Conf. reserved to the P.Flow sensor (AWM3300). A special trasfer function is applied to this channel to linearize the answer.

Since an hardware adjustement is necessary to change the input from current to voltage these field must considered read only.

FullScale / LowScale : see the previous paragraph. Except for the Polytron IR CO2 the changement of these value is not allowed.

Instructions to change the Polytron IR CO2 full scale are reported in the following pages .

Gain / Offset : The reading of the channel can be scaled using these 2 values as result of the formula:

$$R_o = R_i \bullet OffSet + Gain$$

Use the Gain/Offset to correct the answer of a detector. **Default** values are Gain=1 Offset = 0.

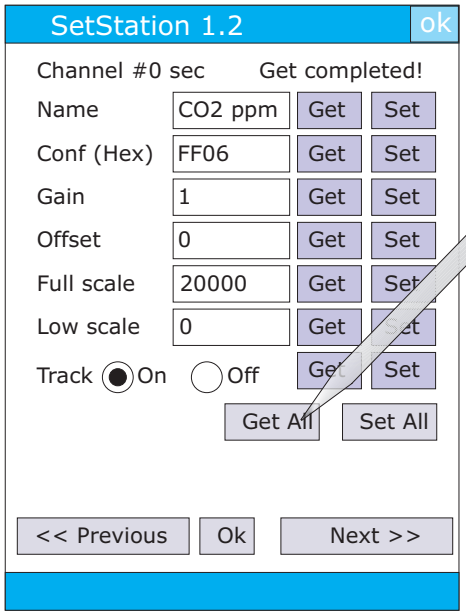
Track On/Off : If you select Track=On a flux curve will be acquired for the selected channel.

The Track must be set to ON for the Channel #0 CO2, in order to have a flux curve for the carbon dioxide.

Normally the other channels are set with track off to save SD card memory space and to reduce the quantity of data to be trasmitted.

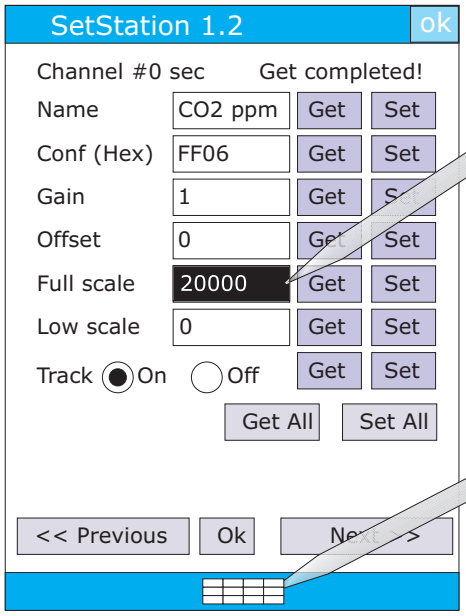
Changing the Drager Polytron IR CO2 full scale value.

Select the **Channel #0**



Press [Get All] to read from station the parameters of the Channel 0

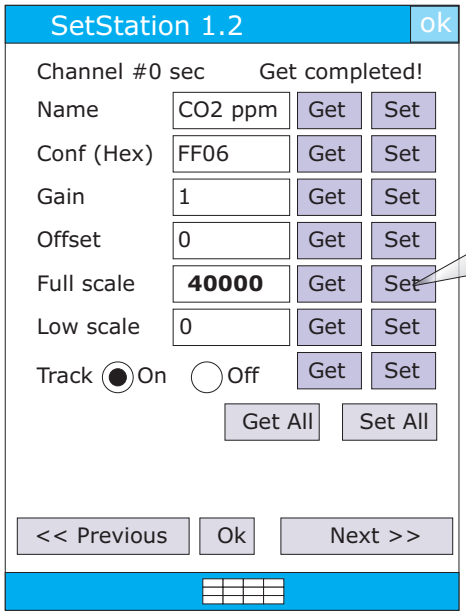
In the example the Full Scale value of Drager is set to 20000ppm. If , for instance, you'd like to put the full scale value of 4% of carbon dioxide you've to set it on both FluxStation and Drager Polytron IR detector.



Select the FullScale value field.

Then activate the "virtual" keyboard

Write the new value, espressed in ppm, in the field: 40000



Press the button [Set] to write the value on the FluxStation.

Now you've to set the same value on the Drager Polytron IR CO2 detector.

Changing the Drager Polytron IR CO2 full scale value.

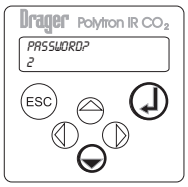
You've to change the full scale value of the detector when:

- Low Fluxes: You can't appreciate the carbon dioxide concentration variations because masked by the "noise". In this case you've to decrease the full scale value;
- High fluxes : The concentration reach the full scale value in few seconds. In this case you've to increase the full scale value;

Also if it's possible to set the full scale value in a big range we advise you to use a full scale value between 10,000 (1%) and 300,000 (30%).

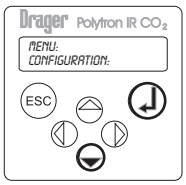
- When the full scale value is less than 10,000 ppm the linearity of Drager detector reduces and you'll obtain no very well shaped curves;
- When the full scale is more than 30% the accuracy of detector is reduced and you can have a big error evaluating the flux.

To change the full scale value of the carbon dioxide detector turn on the detector by running SetStation from the PDA.

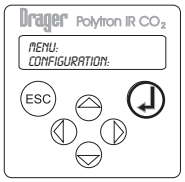


Press the ***enter*** key,
then the display will ask to enter the password

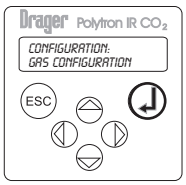
Press the ***DN*** key twice to set the password = 2
then press ***enter*** to confirm



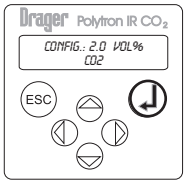
Now press the ***DN*** key twice the display will show
MENU:
CONFIGURATION:



Now press the ***enter*** key to enter in the configuration menu

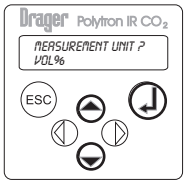


Now press the Enter key to enter in the gas configuration procedure



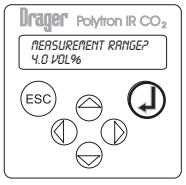
The display shows the actual configuration :
2.0 VOL% CO2

Press Enter key to proceed

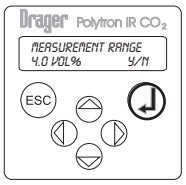


If you plan to set a full scale value > than 9999 ppm select the unit **VOL%** else select **ppm** using the **UP / DN** arrows.

Press **Enter** to proceed.

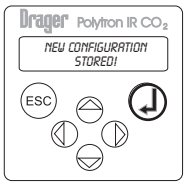


Set the full scale value you want to use, taking account that 1%=10000 ppm, then press **Enter** to proceed

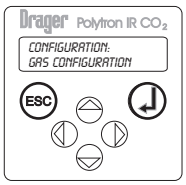


Now the DRAGER ask you to confirm by selecting **Y**es and pressing **Enter**

Changing the Drager Polytron IR CO2 full scale value.



Press **Enter** key to proceed

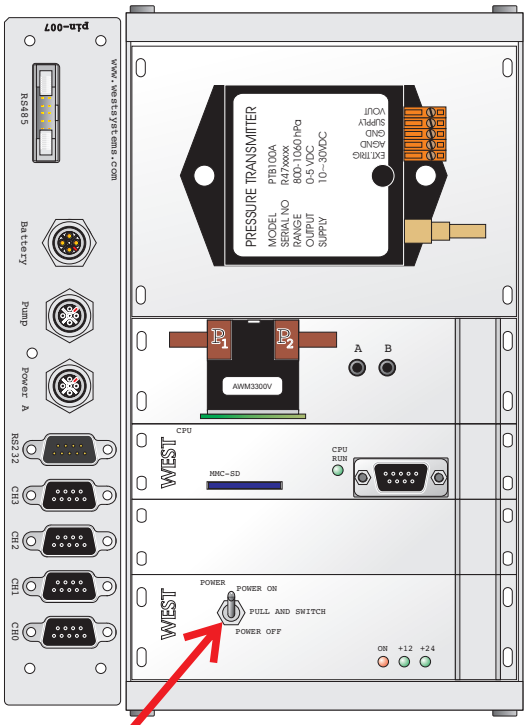


Press **Esc** twice and **Enter** to come back at the measurement.

Remember now to set the same value on the flux station, if not already done

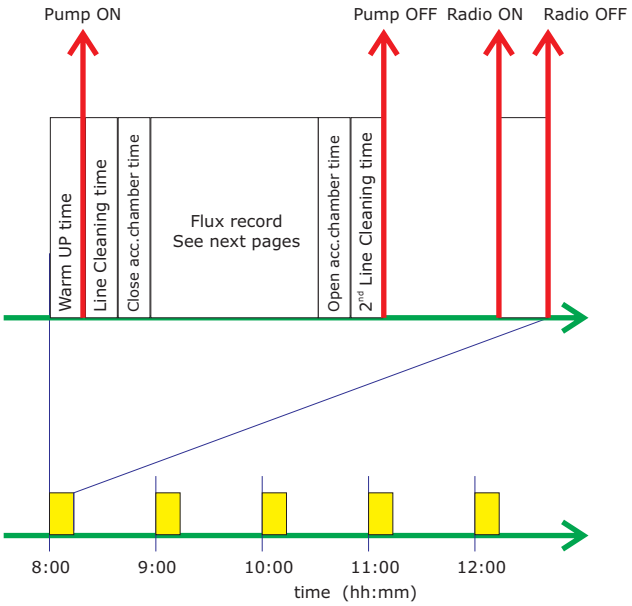
Running FluxStation

Quasi-continuous monitoring



To turn on the FluxStation Pull up and switch on the power switch..

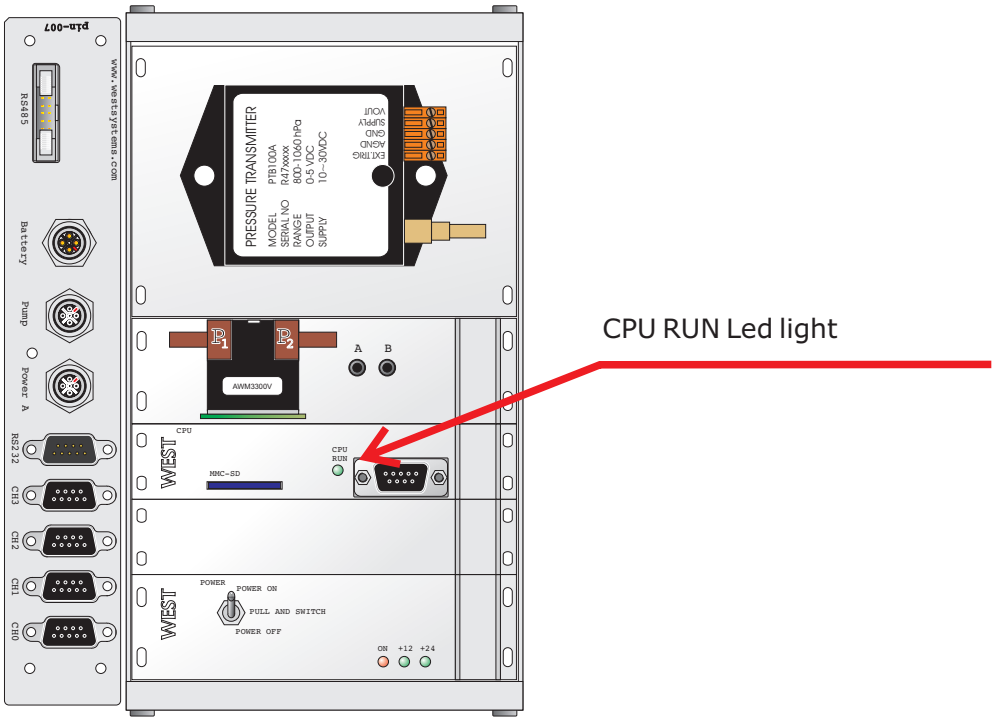
After a quick boot the FluxStation starts the quasi-continuous monitoring task.



Following the configuration parameters the station performs one analisys cicle eevery hour (By default). See chapter 6.

Running FluxStation

Quasi-continuous monitoring



When the FluxStation runs the CPU RUN light flashes every second.
.

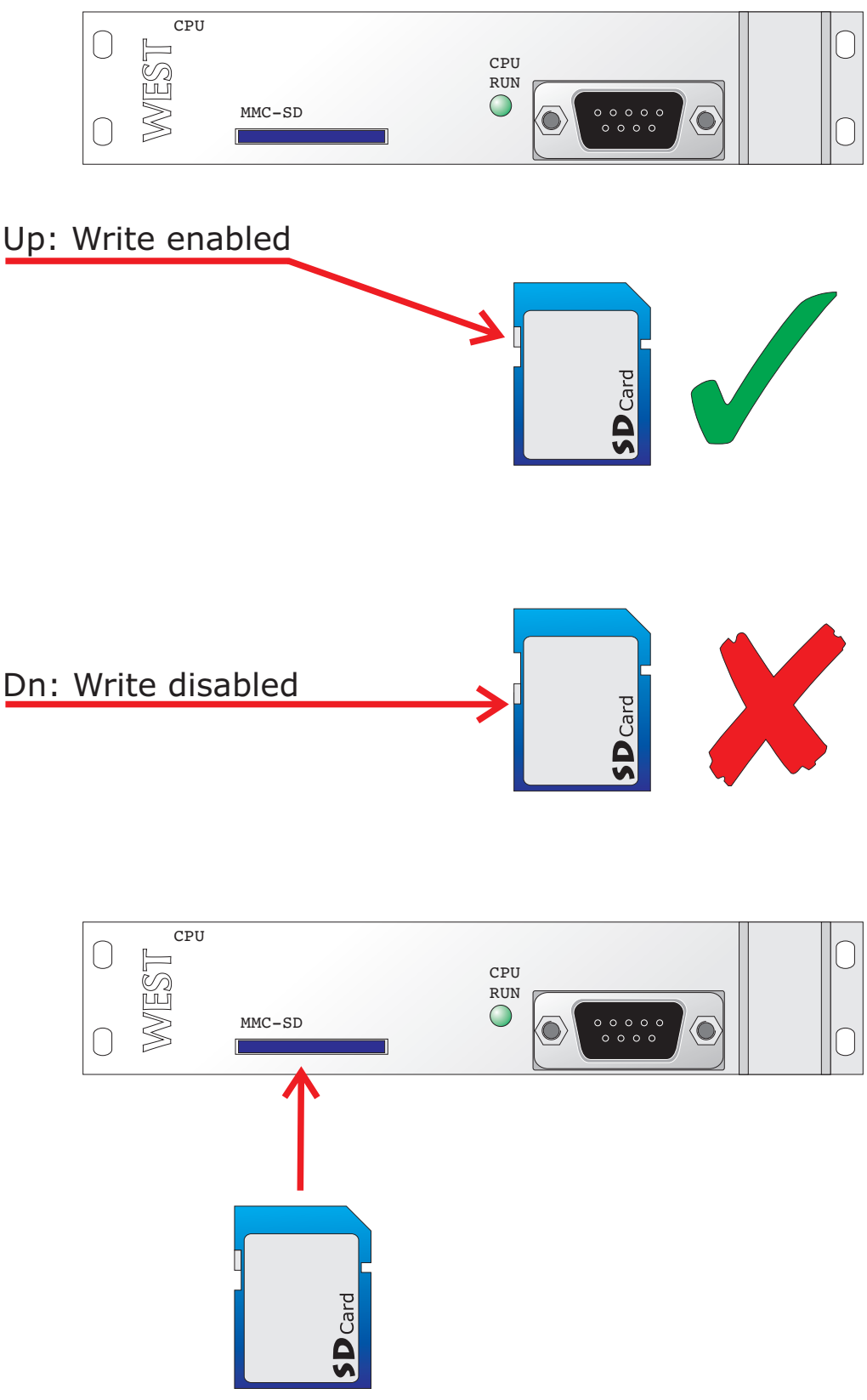
The FluxStation stores the result of analisys cicles on a SD memory card. By using SetStation PDA software you can initialize and check it (Page 6.4).

The SD card is formatted using the FAT32 file system and can be read directly from Windows XP / Vista on a PC..

Each analisys cicle requires a couple of kilobytes on the SD card, but due to the file system the "disk dimension" of file is 16 KBytes. Then for the default sampling frequency are necessary 0.384 MBytes/day (140 M.Bytes /year).

We advise to use 512 MByte SD memory card.

Before to insert the SD memory card in the CPU slot verify that the Write On/Off swicth of the card is in the enabled position.



Running FluxStation

Quasi-continuous monitoring

After inserting the SD card check with SetStation (Page 6.4) that the FluxStation recognized the SD card.

FluxStation write on the card at the end of the measurement cicle. To remove the card in this period can cause the loss of data.

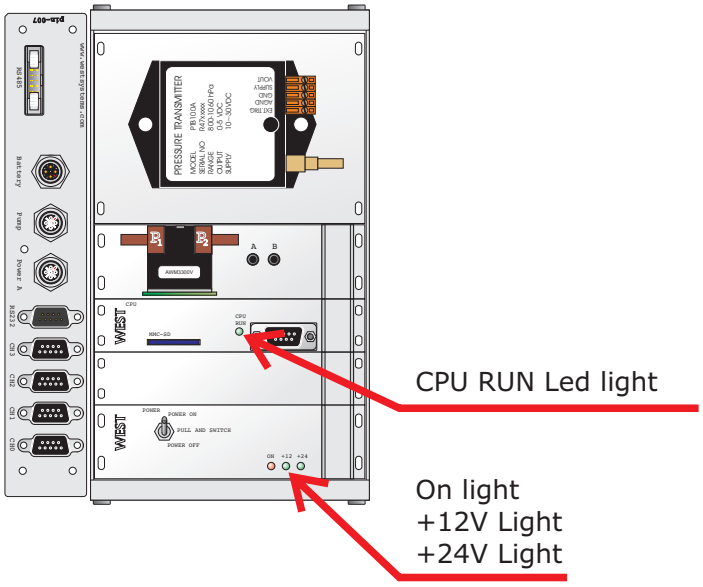
In order to inform the operator of the next writing operation, the CPU run led light will be solid ON for a 60 second period before start to write on the card.

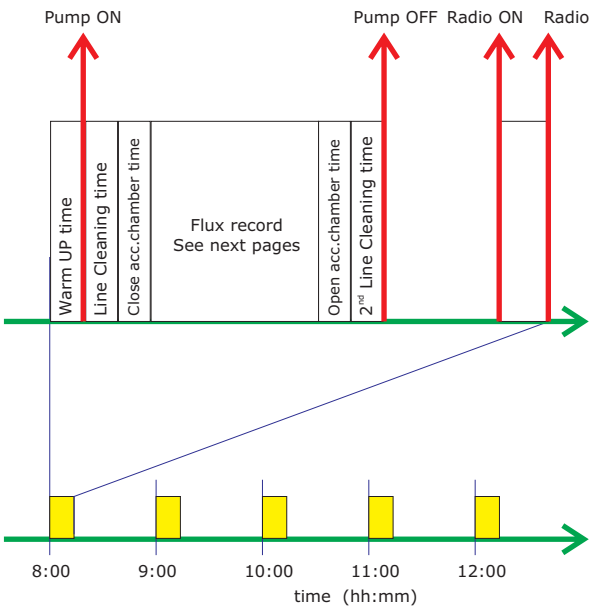
Then if you have to swap the card on the FluxStation you've to:

- Prepare the empty SD card;
- Check that the "CPU RUN" led light is flashing once per second;
- Remove the card on the slot;
- Place the empty card in the slot.

Running FluxStation

Station status





The station has two working states:

1) StandBy: the time between the analisys cicles;

2) Analisys cicle (Yellow boxes in the drawings).

Stand-by state

During the stand-by state the CPU RUN led light, on the CPU board, flashes once per second and the ON light on the Power board is solid ON.

Analisys running state

While the analisys cicle is running the CPU RUN led light, on the CPU board, flashes once per second and the ON light on the Power board is solid ON. The +12V and +24V led light are solid ON (or OFF) depending on the phase of the analisys.

Calibrations

General discussion

The subjects regarding calibration of your instrument for the measurement of diffuse flux will be discussed in this chapter.

As explained previously the flux measurement is proportional to the slope of the concentration curve versus time. The proportionality factor depends on the volume/surface ratio of the accumulation chamber used for the measurement, as well as, the barometric pressure and air temperature at the moment of making the measurement.

The most important aspect to understand is that the flux is proportional to the gradient of concentration over time: ppm/second.

This aspect allows us to simplify the control of the response of the gas sensors utilised.

To simplify the explanation see the following example:

Calibration control example:

Before verifying the calibration turn on the detectors using the PDA and SetStation (Chepter 6) and leave it on for a minimum of 2 minutes to warm up.

Step1: Verifying the zero:

Fill the Tedlar gas bag with nitrogen, or synthetic air and connect it to the inlet port of the instrument, turn on the pump (using SetStation) and read the concentration of carbon dioxide on the Polytron Display. Obviously, it is important that the mixture not contain carbon dioxide. In the absence of a standard mixture with these caracteristics you can intake atmospheric air trapping the carbon dioxide with soda lime or a *drager tube* for carbon dioxide.

The method for injecting standard gas mixtures is explained in detail in the following pages.

Step2: Verification of the span:

Fill the tedlar gas bag with a standard mixture containing approximately a concentration of carbon dioxide equal to the 70% (between 50% up to 95%) of the full scale value of the Drager and check the response of the instrument.

If the full scale value of Drager is set to 20000 ppm (1.5%) you can use a standard with a concentration of CO2 in the range 10000 .. 19000 ppm. If the concentration is less than the 50% of the full scale value you will increase the calibration error.

Let's suppose that the check performed gave the following results:

Injecting a mixture at zero concentration of carbon dioxide the CO2 detector returns a reading of 10 ppm.

Injecting a mixture containing a 10,000 ppm concentration of carbon dioxide the CO2 detector returns a reading of 9940 ppm.

At a variation of concentration set at 10,000 ppm the instrument has a slightly different response: 9930 ppm (=9940-10 ppm). The evaluation error is of about 70 ppm, which in percentage points over the span corresponds to 0.6% less

The error in evaluating the increment in concentration manifests as a systematic error in the evaluation of flux and, therefore, must be corrected by calibrating the instruments when it is too high (> 5%).

Full scale and calibration

When you change the full scale of the detector, to reach the maximum of accuracy a re-calibration could be necessary.

In our experience, if the changement is not so drastic, the detector is still calibrated also after the changement of full scale.

Drastic / not drastic....
If you change the FS from 2% to 4% you can consider the Drager still calibrated. If you change the full scale from 1% to 30% you have to recalibrate the detector.

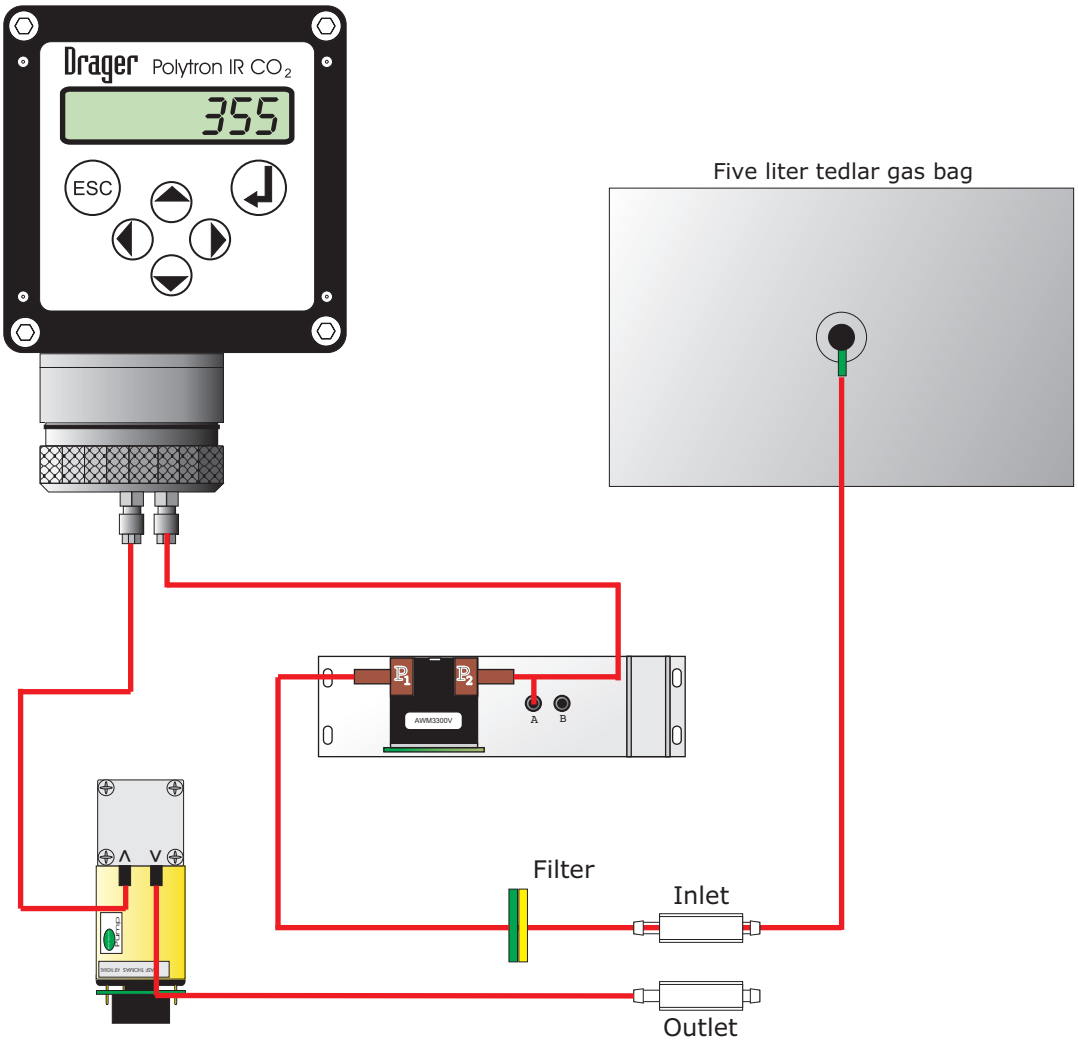
Calibration of Drager IR CO_2

When you need to calibrate the Drager

The Drager is a quite stable detector, the thermal stabilization features allows the instrument to maintain it calibration for long periods. The calibration is necessary only when there is a drastical change in the barometric pressure.

What you need to calibrate the Drager

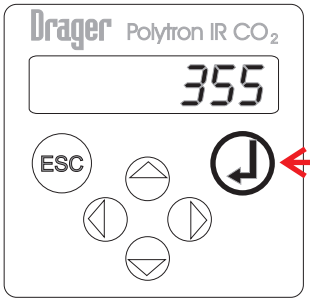
- A cylinder of nitrogen or synthetic UPP Air, or a SODA LIME trap or a DRAGER PIPE to trap the carbon dioxide.
- A cylinder of standard mixture of 1% of carbon dioxide in air (or nitrogen);
- A five liters TEDLAR gas bag.



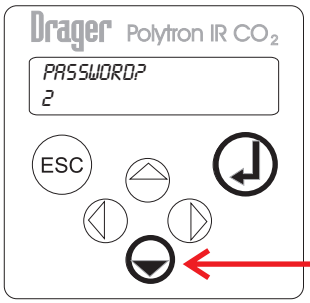
Note on the reading of Drager

The reading of Drager is affected by a "noise" that normally do not exceed the 0.5% of the full scale value: if the full scale value is set to 20000 ppm the noise normally do not exceed 100 ppm peak to peak. This noise do not affect the evaluation of flux except when the increasing of the concentration due to the flux is less than noise...
If you cannot appreciate the variation of concentration you've to reduce the full scale value of your Drager. Please have a look of the chapter 3.

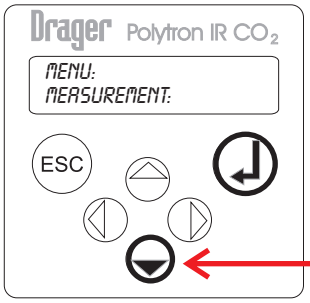
Calibration of Drager IR CO_2



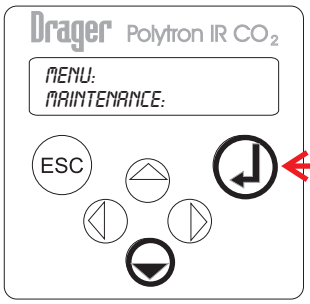
Press the ***enter*** key,
then the display will ask to enter the password



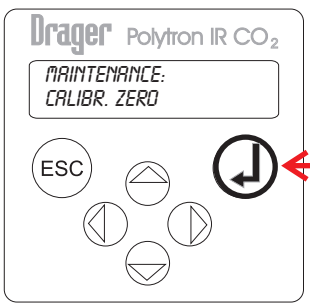
Press the ***DN*** key twice to set the password = 2
then press ***enter*** to confirm



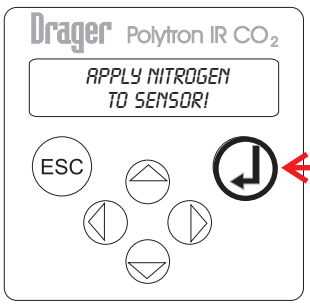
Now press the ***DN*** key up to the display shows
MENU:
MAINTENANCE:



Now press the ***enter*** key to enter in the maintenace menu

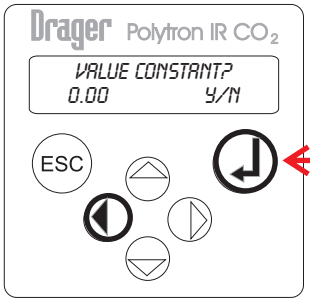


Press the ***enter*** key to enter in the ZERO calibration procedure



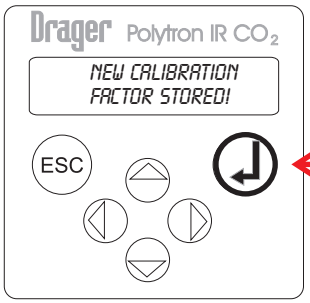
Be sure that the TEDLAR bag filled with CO2 free gas mixture is connected to the inlet port of instrument and Start the pump of instrument by pressing the START button on PalmFLUX. Then press the ***enter*** key to start the ZERO calibration procedure

Calibration of Drager IR CO_2

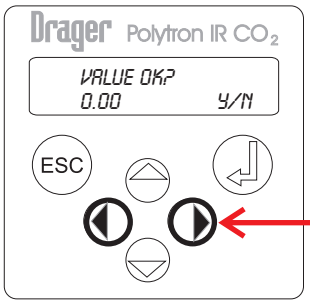


VALUE CONSTANT Step

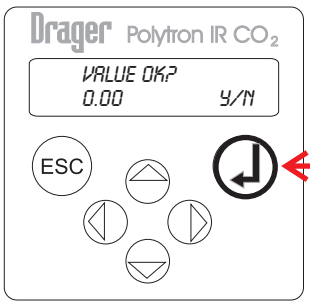
Wait that the reading is stable then select **Y** by pressing the left arrow key then press the ***enter*** key.



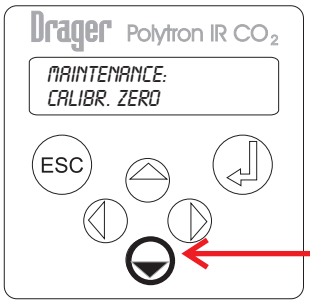
Press the ***Enter*** key to proceed.



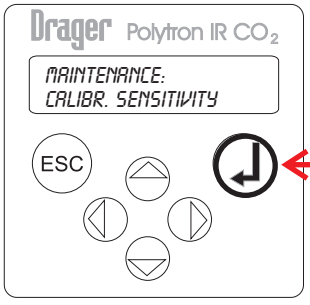
If the reading is OK select **Y**es to proceed else select **N**o to come back to the VALUE CONSTANT step.



Select **Y**es to finish the ZERO calibration procedure

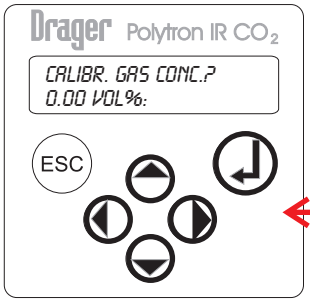


Press the DN key to select the calibration sensitivity menu voice

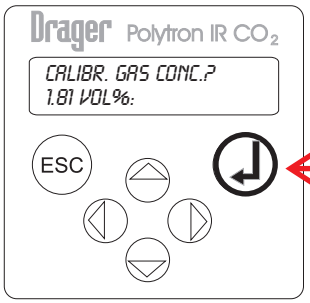


Press enter to access the SPAN calibration

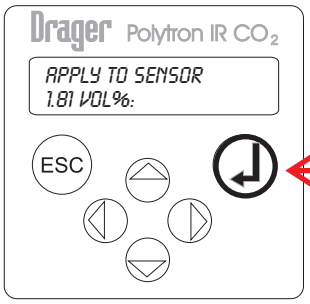
Calibration of Drager IR CO_2



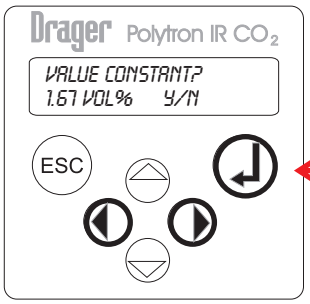
Now you have to set the value of the concentration of CO2 in the gas mixture you'll use for the calibration. Using the ***Left / Right*** keys you can select the digit and using ***Up/Dn*** keys you can change the value. If you're using a 18100 ppm CO2 concentration standard gas you've to set: 1.81 %Vol



Press ***Enter*** key to accept the value you set and proceed

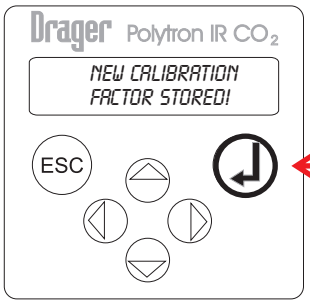


Be sure that the TEDLAR bag filled with the CO2 standard gas mixture (18100 ppm of CO2) is connected to the inlet port of instrument and Start the pump of instrument by pressing the START button on PalmFLUX. Then press the ***enter*** key to enter in the SPAN calibration procedure. Remember that using a 5 liter TEDLAR bag you have 4-5 minutes to complete the procedure.

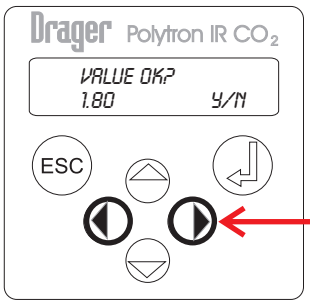


VALUE CONSTANT Step

When the value is constant select **Y**es, using the ***Left/Right*** keys , and then press ***Enter*** key to proceed.

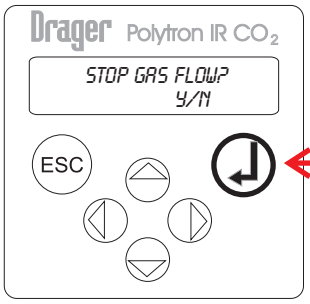


Press the ***Enter*** key to proceed.

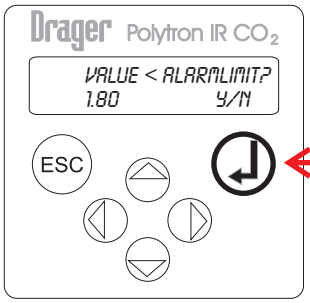


If the reading is OK select **Y**es to proceed else select **N**o to come back to the VALUE CONSTANT step.

Calibration of Drager IR CO_2



Select **Y**es and press ***Enter*** to proceed.



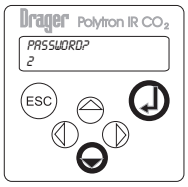
Select **Y**es end press ***Enter*** to finish the span calibration procedure.

Now the DRAGER detector is calibrated.

Calibration of the 4-20 mA interface of Drager

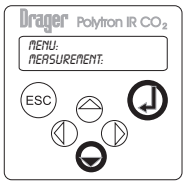
This calibration procedure can be necessary if the reading odf CO2 concentration on the FluxStation and the reading of the Drager are different. Normally there is a small difference between the DRAGER and FluxStation; This is due :

- to the resolution of the display of Drager: +/- 10 ppm and +/- 100 ppm if the full scale is more than 10000 ppm;
- to the analog to digital conversion;
- to the leak of linearity of DRAGER in some ranges.

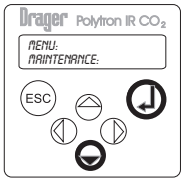


Press the ***enter*** key,
then the display will ask to enter the password

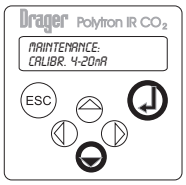
Press the ***DN*** key twice to set the password = 2
then press ***enter*** to confirm



Now press the ***DN*** key up to the display shows
MENU:
MAINTENANCE:

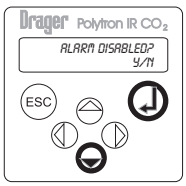


Now press the ***enter*** key to enter in the maintenace menu

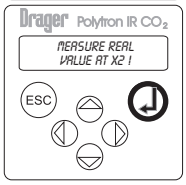


Now press the ***DN*** key up to the display shows
MAINTENANCE:
CALIBR. 4-20 mA

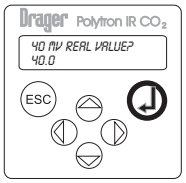
then press Enter to access the 4-20 mA calibration procedure



Select Yes using the **left arrow** key and press **Enter** key



Press **Enter** key to proceed



In this phase the reading of concentration in the SetStation application must be zero, more or less a tolerance value and a little noise. If the value you read is not correct you can adjust it.

An example: The Drager (and the fluxStation) full scale value is set to 20000 ppm and the reading you're having is 150 ppm instead of 0.0 ppm.
You've to compute the "real value" using the following formula:

$$\text{RealValue} = \frac{\text{OffSet} + (\text{FS}/4) \cdot 160}{\text{FS}}$$

Where :

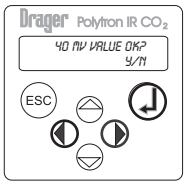
- FS is the full scale value (20000 ppm in the example);
- OffSet is the value expressed in ppm you're reading on the palmtop (150 ppm in the example)

Then RealValue = (150+(20000/4)*160)/20000 = 41.2

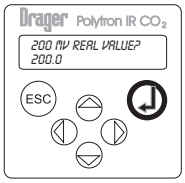
Set 41.2 using the arrows and press enter to confirm

Calibration of the 4-20 mA interface of Drager

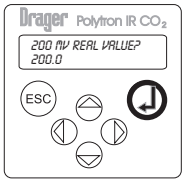
Press **Enter** key to proceed



The drager ask **40 mV value OK?**
If the reading on Palmflux now is good select Yes and then press **Enter** key to proceed, else select N to repeat the calibration



Now the Drager shows: **200 mV REAL VALUE?**



In this phase the reading of concentration in the palmflux must equal to the full scale you set on the palmflux, more or less a tolerance value and a little noise. If the value you read is not correct you can adjust it.

An example: The Drager (and the palmflux) full scale value is set to 20000 ppm and the reading you're having is 18900 ppm instead of 20000.0 ppm.
You've to compute the "real value" using the following formula:

$$\text{RealValue} = \frac{\text{Reading} + (\text{FS}/4)\cdot 160}{\text{FS}}$$

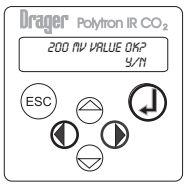
Where :

- FS is the full scale value (20000 ppm in the example);
- Reading is the value expressed in ppm you're reading on the palmtop (18900 ppm in the example)

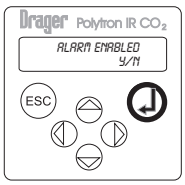
Then RealValue = (18900+(20000/4)*160)/20000 = 191.2

Set 191.2 using the arrows and press enter to confirm

Press **Enter** key to proceed



The drager ask **200 mV value OK?**
If the reading on Palmflux now is good select Yes and then press **Enter** key to proceed, else select N to repeat the calibration



Now the Drager shows: **ALARM ENABLED?**
Select **Y**es and press **Enter** Key

Now the 4-20 mA of drager is calibrated.

Calibration of the flux meter

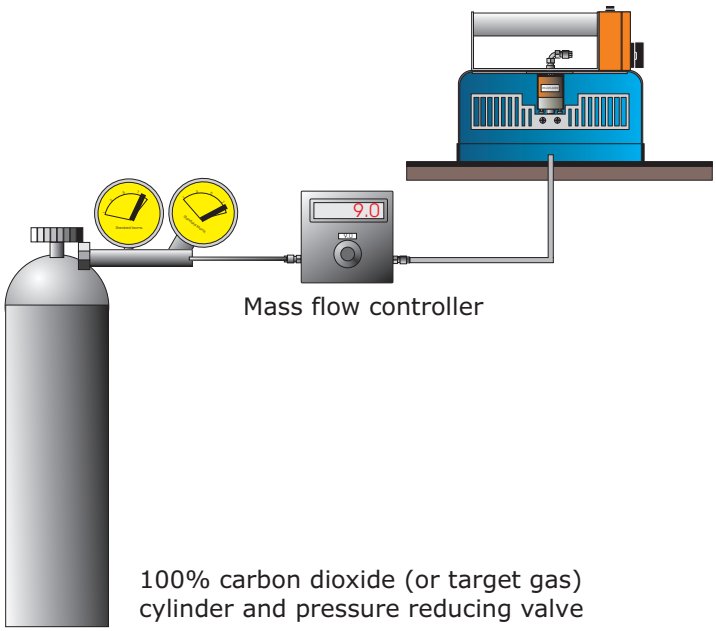
Fluxmeter calibration

As the computation of flux is a function of the gradient of concentration vs. time, barometric pressure, air temperature and the accumulation chamber volume / surface ratio, **the calibration of the instrument depends only on the detector calibration**. The accuracy of the barometric pressure and air temperature measurement affect the evaluation of flux: 3 degrees Celsius of error while evaluating the temperature will cause a 1 % of error when computing the flux. A 10 HPa (mBar) error measuring the barometric pressure will cause a 1% error in the flux evaluation.

How to verify the fluxmeter calibration

The calibration described refers to carbon dioxide calibration, for other gases, like methane or hydrogen sulphide, the same procedure has been followed.

Sketch of calibration device



CO_2 fluxes from soil are simulated by injecting a known flow of gas into the accumulation chamber. The interface between the accumulation chamber and the calibration table is built to minimize the gas leakage.

The apparatus is schematized in figure 1.

For flux between 0.5 and 300 moles/(m^2day) the injected flux is controlled and measured with a precision mass flow controller. This MFC, calibrated for CO_2, is electronically stabilized (Accuracy 1%).

Calibration of the flux meter

Fluxmeter calibration

For fluxes between 300 moles/(m^2day) and 700 moles/ (m^2day) the injected flux is controlled by means of a mechanical flow reducer and measured using a bubble flowmeter (Accuracy 3%) before and after the flux measurement with the accumulation chamber.

Two series of measure were performed for flux of 300 moles/(m^2day) to evaluate the coherence between the two different methods of flow measurement.

A thermometer and barometer were utilized to measure the barometric pressure and the air temperature during the experiment in order to select the correct accumulation chamber conversion factor.
A flow meter is utilized to measure the pumping flow during the experiment.
During all the measures a 100% CO_2 flow was utilized.
The same procudure was utilized to check the instrumental response to methane / Hydrogen Sulfide.

Calibration of the flux meter

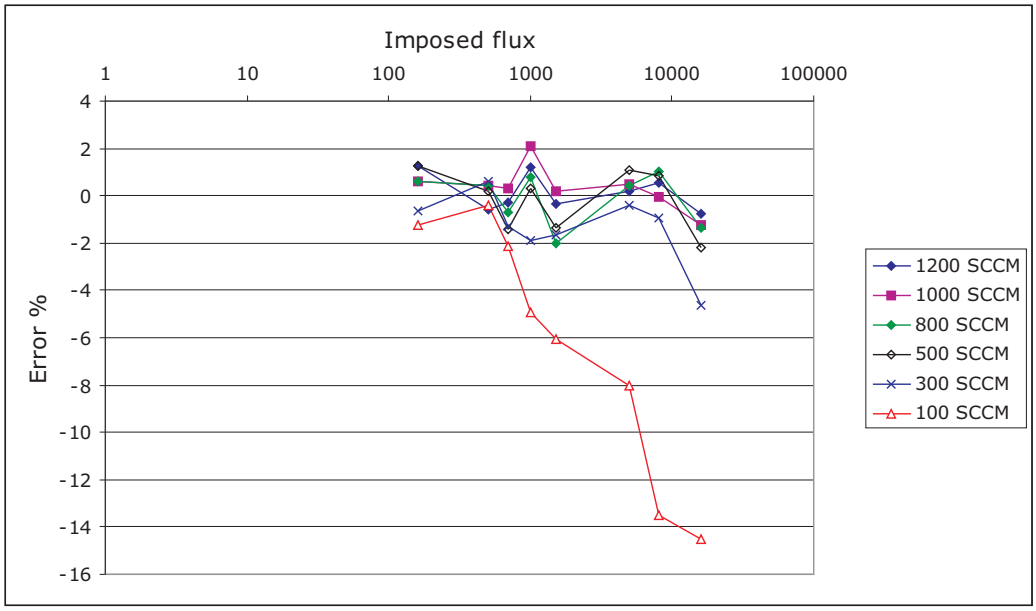
The influence of pumping flow

Influence of pumping efficiency on the flux measurement results:

We have carried out some sets of measures utilizing the same injected flux but with different pumping flow from the accumulation chamber to the detector.

The pumping flow was changed by means of a mechanical flow reducer and measured with a Microbridge Mass Airflow sensor (Accuracy 2%).

We have not noted a significant variation of the measures except when the pumping flow is less than 200 SCCM.



In the diagram the plot of the measurement error versus the imposed flux of carbon dioxide (expressed in grams per square meter per day) at different pumping flow rates is shown.

In order to avoid unwanted variation of pumping flow due to power supply the pump is supplied at 12 V DC with a stabilized voltage regulator.

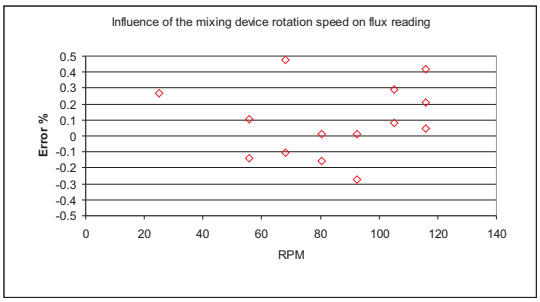
The pumping flow , after the power supply stabilization, is 1000 SCCM ± 20%. The efficiency of pump can vary due to dust or moisture in the pump body. Periodic maintenance is necessary.

Calibration of the flux meter

The influence of mixing device

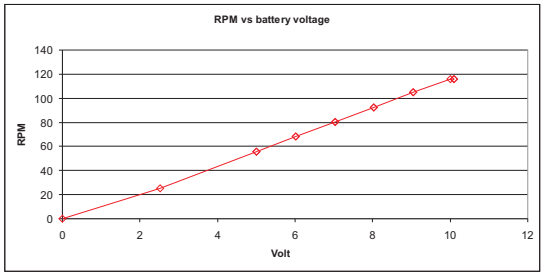
The mixing device was suspected, by some researcher, to affect the accuracy of the flux measurement.
In our experience the precision of the measurements was noteably reduced without a mixing device present.
In the two plots below the measurements at various regimes of mixing device rotation are reported.

Influence of the mixing device rotation speed



In the plot the measured flux vs the mixing device rotation speed.

Battery status vs RPM.



In the plot the mixing device RPM (Rotation per minute) vs power supply voltage. The normal range for the battery voltage is between 9.6 V (new battery) and 6 Volt (discharged battery)

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Databases structure

The databases

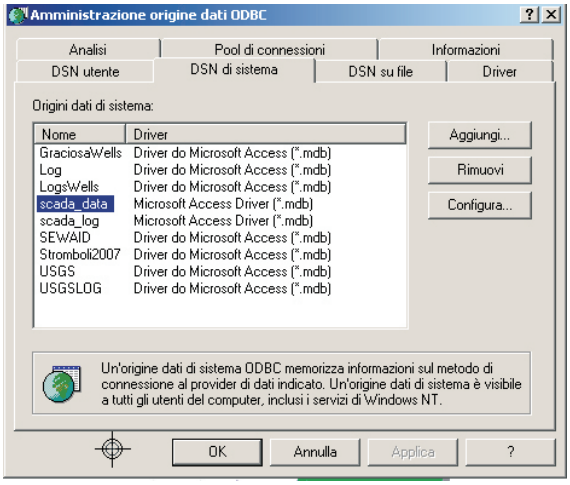
All the information necessary to run scada, as well as the data acquired by the fluxstation, are stored in a single file : ***scada_data.mdb***

A second database : ***scada_log.mdb*** is used by Scada to log messages, error reports and other information that are generated by scada and that can be helpful to diagnose some malfunctions of the system.

Both are *file based* databases in the MS Access format.

These two file are located in the ***C:\WEST\SCADA*** folder

The two databases are accessed by our software via ODBC, then two System DSN (Data source name) definitions are added by the Scada setup.


Amministrazione origine dati ODBC
Analisi
Pool di connessioni
Informazioni
DSN utente
DSN di sistema
DSN su file
Driver
Origini dati di sistema:
Nome
Driver
GraciosaWells Driver do Microsoft Access (*.mdb)
Log Driver do Microsoft Access (*.mdb)
LogsWells Driver do Microsoft Access (*.mdb)
scada_data Microsoft Access Driver (*.mdb)
scada_log Microsoft Access Driver (*.mdb)
SEWAID Driver do Microsoft Access (*.mdb)
Stromboli2007 Driver do Microsoft Access (*.mdb)
USGS Driver do Microsoft Access (*.mdb)
USGSLOG Driver do Microsoft Access (*.mdb)
Aggiungi...
Rimuovi
Configura...
Un'origine dati di sistema ODBC memorizza informazioni sul metodo di connessione al provider di dati indicato. Un'origine dati di sistema è visibile a tutti gli utenti del computer, inclusi i servizi di Windows NT.
OK
Annulla
Applica
?

The first system DSN is ***scada_data*** , it has a MS Access (.mdb) driver and it point to the file *C:\WEST\Scada\scada_data.mdb*.

The second system DSN is ***scada_log*** , it has a MS Access (.mdb) driver and it point to the file *C:\WEST\Scada\scada_log.mdb*.

Both DSN are created automatically by the Scada suite setup. Normally it's not necessary to modify it manually.

Databases structure

The four applications of Scada suite read the system DSN from the ODBCName.txt file, located in the *C:\WEST\scada\source* folder

The first line sets the DSN that point to scada_data.mdb and the second line sets the DSN that point to the log database.

Both DSN are created automatically by the Scada suite setup. Normally it's not necessary to modify it manually.

Database *scada_log.mdb*

The database *scada_log.mdb* is composed by several tables:

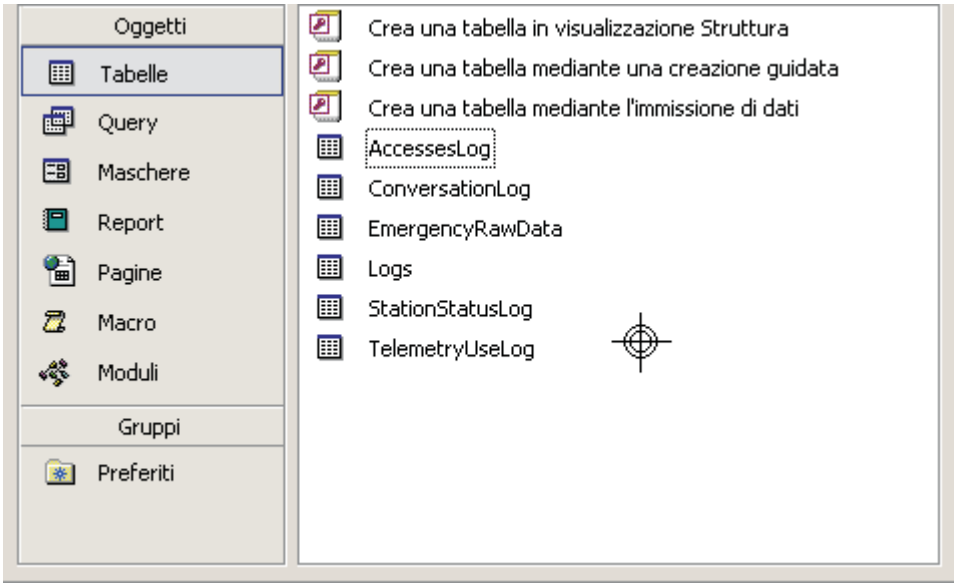
AccessesLog:

ConversationLog: Information about the "conversation between Scada and the FluxStation(s);

EmergencyRawData: Raw data coming from the fluxstations: usefull for malfunction diagnostic;

StationStatusLog: Informations about the status of the fluxstations;

TelemetryUseLog: information about the use of the telemetry system. Designed to check the bill, in case of GSM based telemetries.



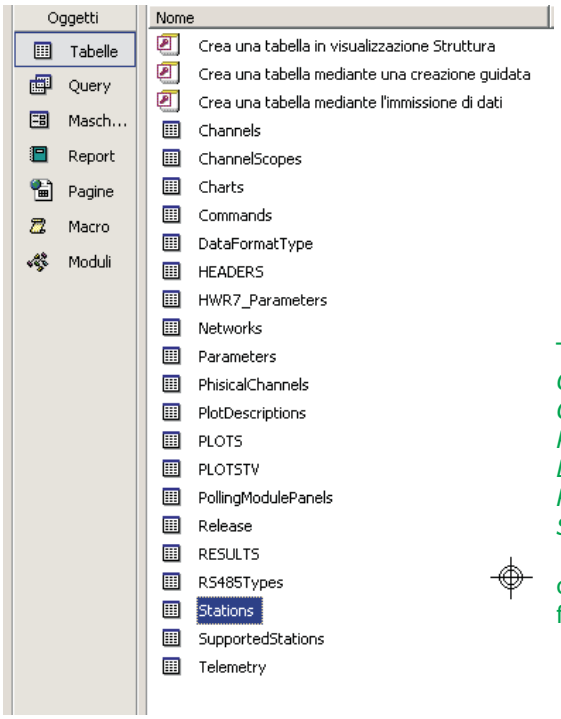
The information in scada_log.mdb is not useful during the "normal" operation of the system. Some of troubleshooting can be understood using its information.

Databases structure

Database *scada_data.mdb*

To understand the structure of the database is not important for the standard use of the system.This information is reported for documentation purpouse.

Scada_data.mdb is composed by several tables, some of them are to define the fluxstations and their configuration. Some of them contain the results acquired by the fluxstations.



The tables:
HEADERS
RESULTS
PLOTS
PLOTTV
contain the data generated by the fluxstations

The tables:
ChannelScopes
Commands
Parameters
DataFormatType
RS485Types
SupportedStations

contain the auxiliary data necessary for the correct working of the Scada

The tables:

Networks
Stations
Channels
PlotDescription
PhisicalChannels
Telemetry
HWRT_Parameters

contain the description of the monitoring network:

Scada, up to now, support only a single network (NetworkID: **WS**), each network can be composed by several Fluxstations.

Databases structure

Database *scada_data.mdb*

Each FluxStation must be defined in the ***Stations*** table.

Field	*Value*	*Description*
ID	13	Record ID (Counter)
Active	-1	-1 = Active // 0 Not active
NetworkID	WS	Has to be **WS**
StationID	OVK01	Identifier of station
StationIP	0001	Address of station
Description	Flux Station 2007	
TelemetryID	SSR24	Type of telemetry
TelemetryName	2427581	* Address of remote telemetry system
TelemetryPath		* Optional repeater address
Site		Name of the site
Latitude		Localization of site
Longitude		Localization of site
Elevation		Localization of site
Responsible		Name of responsible
Type	HWR7	Station type
Model	1	Station subtype
PollingFrequency	24	** See note
PollingTimeShift	00.15.00	** See note
PollingRetryDelay	5	** See note

note *

The **telemetryname** and **telemetrypath** formats and values are depending on the telemetry type (**TelemetryID**). If the station is connected with a serial cable **(TelemetryID = "COM_1")**, or with a point to point radio connection these to fields are not considered, simply because there is not necessity to address the communication. If your system has a SSR24 (SpreadSpectrum radio system) based telemetry you'll find more information about this argument on the Appendix.F

note **

PollingFrequency is the number of telemetry calls that Scada will perform during a day to download the FluxStation data.

PollingTimeShift is a delay, expressed in hh:mm:ss, that will be added to the time of telemetry call: If pollingfrequency is 24 Scada will execute a call every hour plus the PollingTimeShift time. Then Scada will call the station at 1:15, 2:15 , 3:15 and so on. The PollingShiftTime must be synchronized with the radio ON and radio OFF parameters of the FluxStation in order to call the station when the telemetry is ON.

PollingRetryDelay, expressed in minutes, is used in case of fail if the communication. If Scada is not able to call the remote station it retry to call after PollingRetryDelay minutes. If PollingRetryDelay is set to zero Scada will retry to call the station only at the next scheduled time.

Databases structure

Database *scada_data.mdb*

The Site, Latitude, Longitude, Elevation and Responsible fields contain only descriptive data.

Type and **Model** are critical parameters that indicate to Scada how to manage the station and must be not modified.

StationID is the station identifier and cannot to be miodified. The **StationIP** is the logical address of the station and cannot to be modified.

Databases structure

Database *scada_data.mdb*

The PhisicalChannels table contain information about the "phisical" configuration of the station channels.

ID	StationID	Number	Name	FullScale	LowScale	Gain	Offset	Statistics	PlotCurve	Conf	Type
47	OVK01	0	CO2	20000	0	1	0	1	-1	FF06	ANALOG
48	OVK01	1	Bar.P	1060	600	1	0	1	0	FF05	ANALOG
49	OVK01	2	Ch.2	5000	0	1	0	1	0	FF06	ANALOG
50	OVK01	3	Ch.3	5000	0	1	0	1	0	FF05	ANALOG
51	OVK01	4	Ch.4	5000	0	1	0	1	0	FF05	ANALOG
52	OVK01	5	Ch.5	5000	0	1	0	1	0	FF05	ANALOG
53	OVK01	6	dP	1100	600	1	0	1	0	FF05	ANALOG
54	OVK01	7	P.Flow	1000	0	1	0	1	0	FF0F	ANALOG
55	OVK01	1	SOILBOX Soil W.	100	0	1	0	1	0	A0	DIGITAL
56	OVK01	2	SOILBOX Soil W. Raw	35	15	1	0	1	0	A1	DIGITAL
57	OVK01	3	SOILBOX Soil T.	200	0	1	0	1	0	22	DIGITAL
58	OVK01	4	SOILBOX Soil T. Raw	200	0	1	0	1	0	A2	DIGITAL
59	OVK01	169	AIRBOX Air RH	0	0	1	0	1	0	DA	DIGITAL
60	OVK01	170	AIRBOX Air T	0	0	1	0	1	0	D9	DIGITAL
61	OVK01	171	AIRBOX Wind Speed	0	0	1	0	1	0	D7	DIGITAL
62	OVK01	172	AIRBOX Wind Dir	0	0	1	0	1	0	D8	DIGITAL
63	OVK01	173	AIRBOX Rain Gauge	0	0	1	0	1	0	DF	DIGITAL

There are two basic type of "channel": ANALOG or DIGITAL; The heigth analog channels are managed by the AC board of the flux station. The Digital channels are devices (AirBox and SoilBox in the base configuration) that are connected to the station with a serial connection (RS485).

ANALOG

Number is the phisical ADC ID;.
Name is a short mnemonic description;
FullScale and **LowScale** and **Conf** are used to set the type of signal to be read (Voltage or Current) and the range of the detector connected to the channel;
Gain and **OffSet** can be used to scale the result of the measurement;

Statistics change the statistic treatment reserved to the channel;

PlotCurve: Setting to -1 this value force the flux station to acquire a Flux Curve of the signal coming from this detector.

DIGITAL

Number is the logical RS485 ID of the device;.
Name is a short mnemonic description;
Conf is the type device connected;
FullScale and LowScale depends on Conf and must not modified.
Gain and **OffSet** must not modified.

Statistics change the statistic treatment reserved to the channel;

PlotCurve: Setting to -1 this value force the flux station to acquire a Flux Curve of the signal coming from this detector.

Information about how to change the configuration and to sent it to the FluxStation are reported on Chapter 10

Databases structure

Database *scada_data.mdb*

Channels table

The *Channels* table is derived from the *PhisicalChannels* one, integrated with additional records and contain all the "definition" necessary to manage the several signals managed by the station.

Each record define a **channel** , for instance **Air temperature** or **CO2 Flux**.

Most of the field of the table must not modified by the user and are not documented here.

PanelPage: set the Scada panel where the channel information are displayed;

RowOnPanel: set the row on the Scada panel where the information are displayed;

RevisionPriority: When using Query.exe the list of channels will be in descending order and only the channels with RevisionPriority > 0 will be visible;

Monitored: Monitor.exe will show the channels with monitored <> 0, see chapter 11;

MonitoringGroup: see chapter 11;

AlarmType, ActiveThresholds, UPAlarm,UPPrealarm, DnPrealarm, DnAlarm: these fields are related with an "alarm" signal managed by Scada.exe: see chapter 10;

Gain, OffSet: by varing these fields it's possible to scale the result values of the channel, ask to West Systems;

Name, Description: The name and the description of the channels;

Active: If active = -1 the channel will be managed by Scada.exe. To exclude a channel set active=0;

The direct (manual) modification of the *Channels* table can be very critical. Ask support to West Systems before to make any modification.

Databases structure

Database *scada_data.mdb*

Telemetry table

The *Channels* table is derived from the *PhisicalChannels* one, integrated with additional records and contain all the "definition" necessary to manage the several signals managed by the station.

There are 3 possible base types of telemetry (Field *BaseType*:

DISK

The station has not a telemetry system and the data is trasferred via SDmemory card. In the *telemetry* table we defined a telemetry of this base type:

TelemetryID = SD
WindowStart=00:00:00
WindowStop=23:59:59
CommPort= 0
HostID= <blank>
Settings=<blank>
TelemetryType=DISK
BaseType=DISK
CommTimeOut=<blank>

If you want to set this telemetry for your station you've to put the ***Stations.TelemetryID = SD*** in the record of the *Stations* table that define your station.

ETH

The station telemetry system is based on a
ethernet to serial converter (as the Moxa DE211)..

TelemetryID = Moxa_1
WindowStart=00:00:00
WindowStop=23:59:59
CommPort= Socket port of the IP.
HostID= IP address of the Moxa
Settings= RS232 parameters of the RS232 port of the moxa;
TelemetryType=MOXA
BaseType=ETH
CommTimeOut=2000

If you want to set this telemetry for your station you've to put the ***Stations.TelemetryID = Moxa_1*** in the record of the *Stations* table that define your station.

Databases structure

Database *scada_data.mdb*

RS232

The base type RS232 supports several TelemetryTypes:

GSM: Gsm based data modems;

SSR24: Spread spectrum 2.4 or 0.9 GHz in switched mode;

RS232: Direct cable connection.

The base type RS232 supports several TelemetryTypes:

The configuration of each type is described in the telemetry handbook.

SSR24 : Appendix F;
GSM : Appendix G; (not included)
RS232 : Appendix M;

General settings:

WindowStart, WindowStop: are used to define an activity time window for the telemetry: If Scada.exe has to share the telemetry with another application is possible to define a time window, for instance between 11:00:00 and 16:00:00.
Scada.exe will use the telemetry system only during this interval.

CommTimeOut: Is a TimeOut interval, expressed in milliSeconds. The communications can suffer of latency times (as for example a Moxa device connected via a IEEE802.xx network, or via an ADSL connection). By setting a proper value to CommTimeOut can solve the problems due to long latency times.

Scada software suite

General description

The software suite of Scada is composed by 4 applications:

Scada: This application , designed to run continuosly, performs the polling of the stations in your network, downloads and stores the data in a database and allow you to configure and manage the remote statios using a telemetry system.

FluxDataRevision: This application allows you to review the flux curves acquired by the FluxStations.

Monitoring: This application allows you to have a "quick view" of the data acquired by the FluxStations.

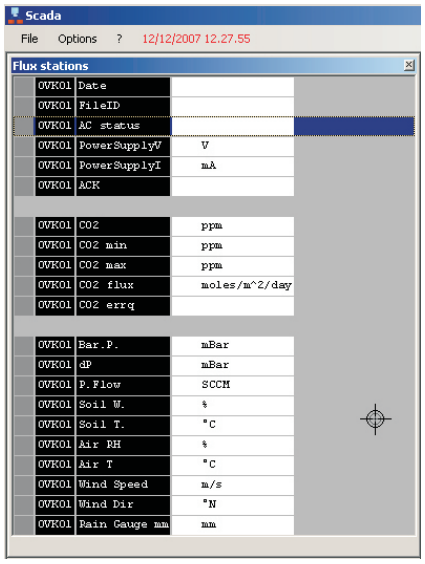
Query: This application allows you to query the database and obtain a table in the .xls format of the data stored in the database.

Scada

Scada reads the network configuration from the scada_data ODBC data souce name (Chapter 9).

Once reads the configuration it runs continuosly to manage the information of all the stations that compose your network.

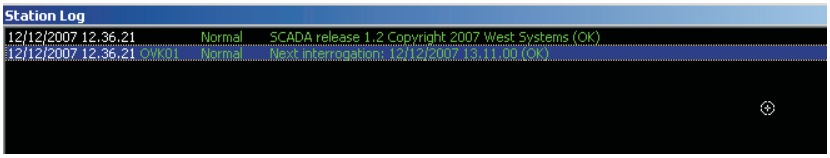
The application shows several information.



Scada Panel

The Panel form resume all the information of the station and its channels;
In the first column is reported the name of the station (Stations.StationID).
In the second column the name of each channel (Channels.Name) and in the third column the result (empty in the example) of the last downloaded measurment and the unit.

Station Log dialog box


Station Log
12/12/2007 12.36.21 Normal SCADA release 1.2 Copyright 2007 West Systems (OK)
12/12/2007 12.36.21 OVK01 Normal Next interrogation 12/12/2007 13.11.00 (OK)

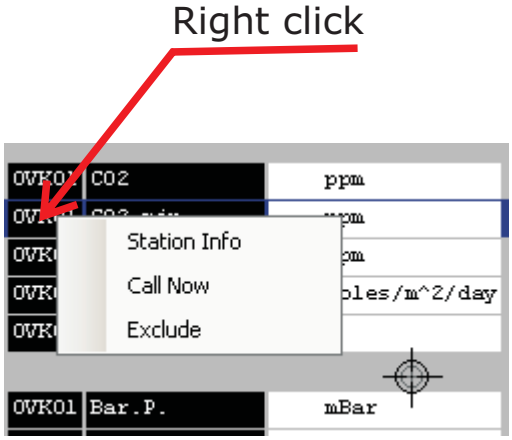
The dialog "Station log" reports all the events related with the management of station and telemetries. These information are saved in the ***Conversation*** table of the **scada_log** database.
Normal events are reported in green, **Warnings** are reported in yellow and **Alarms** and **Errors** are reported in red.
In the drawing, after the CopyRight message, a Normal event is reported:
The next interrogation of the OVK01 station is scheduled at 13:11:00 of 12/12/2007.

The log can be saved as text file by right clicking the text box and selecting {Save as}.

Scada software suite

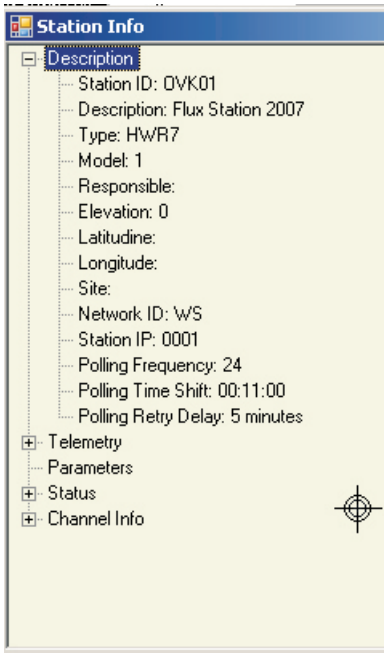
Scada application

On the left-top corner of Scada the pc clock is shown: Scada will use this date/time information to set the clock of each station managed every time it will be able to talk with the station. Then to avoid confusion in the data you get you must check that the PC clock is correctly set.



By right clicking on the StationID field of a station a menu appears.

{Station Info}



By selecting {StationInfo} you can get a report where all the information about the station, the telemetry , the configuration parameters, the status and about all the channels that belong to the station are present. The StationInfo report will be automatically closed after 30 seconds.

{Exclude}

By selecting {Exclude} you can temporary exclude the station. While excluded a station is not managed by the application. This feature is normally used when a station is under maintenance to avoid useless telemetry calls. While excluded the background color of the station will be red. To reactivate the station select {Include} from the same menu.

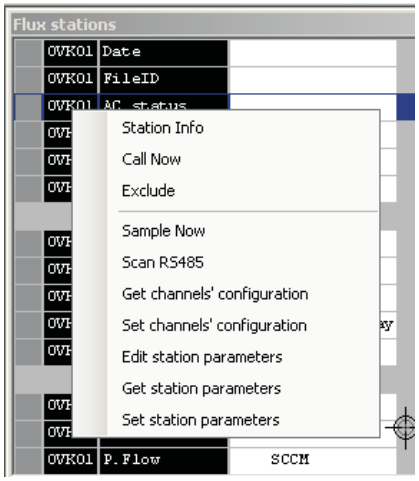
{Call Now}

By selecting {Call Now} the application re-schedule the next call to now. Of course you've to consider that the remote telemetry system can be off and then the call will be not successful.

Scada software suite

Scada application

{Options} menu



By selecting {Options}{Show advanced menu} an advanced station menu will be enabled, then now right clicking the StationID field a more complete menu is shown.

{Sample Now}

By selecting {Sample Now} you force the immediate execution of an analisys cicle. The command will be sent to the station during the next call, then to have an immediate effect {Sample Now} must be followed by {Call Now}.

{Get channels configuration}

By selecting {Get channels configuration} the application will download the configuration of the channels from the station and will store this configuration in the database. The action will be performed during the next scheduled call.

{Set channels configuration}

By selecting {Set channels configuration} the application will upload the configuration of the channels from the database to the station, reconfiguring the station with the database settings. The action will be performed during the next scheduled call.

{Get station parameters}

By selecting {Get station parameters} the application will download the timing parameters of from the station and will store it in the database. The action will be performed during the next scheduled call.

{Set station parameters}

By selecting {Set station parameters} the application will upload the timing parameters from the database to the station and will re-configure the timings of the analisys cicle. The action will be performed during the next scheduled call.

{Edit station parameters}

By selecting {Edit station parameters} the application allows you to modify the timings of the analisys cicle (parameters) and to save it in the database..

Since all the actions described in this page, except {Sample Now}, are quite critical we advise you to follow this procedure:

a) Do NOT get or set the channels configuration unless big malfunction of the system. Anyway before to do that call us.

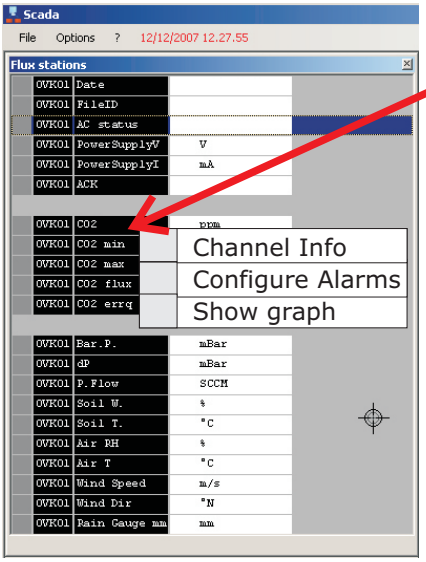
b) To change the parameters:

1) select {Get Station Parameters}; wait the next successful call;
2) Edit the parameters {Edit station parameters} and save into the database;
3) select {Set Station Parameters}; wait the next successful call;

Now the station is set with new parameters

Scada software suite

Scada application

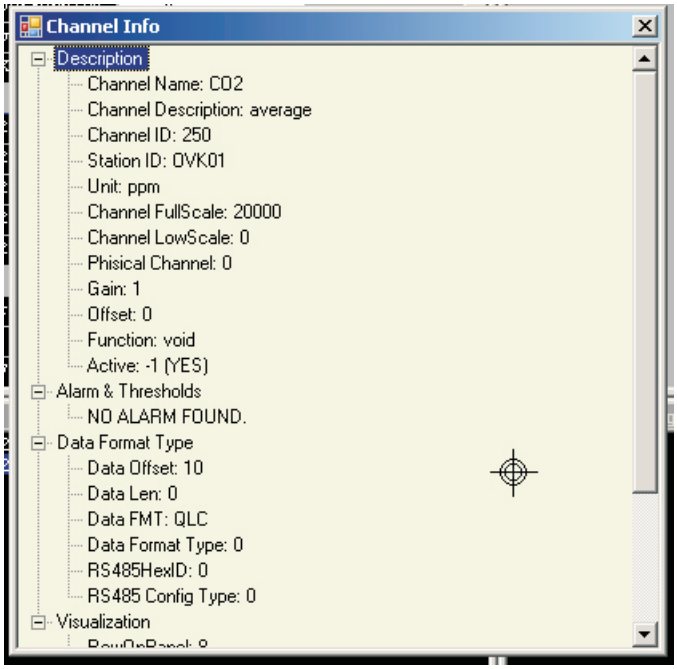


Right click

By right clicking on the Channel.Name field of a station a menu appears.

{Channel Info}

By selecting {Channel Info} a report of the channel configuration and status will be shown.



{Configure Alarms}

By selecting {Configure Alarms} will be possible to set alarm level and modalities for the channel.

All thresholds / only upper thresholds / only lower thresholds / Alarm not active;

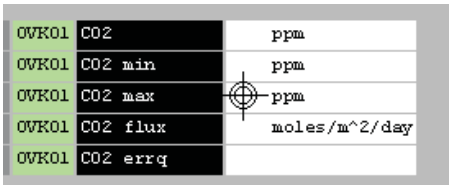
{Show graph}

By selecting {Show Graph}, active only for the channels that are configured to be acquired as flux curve, the last downloaded curve will be displayed.

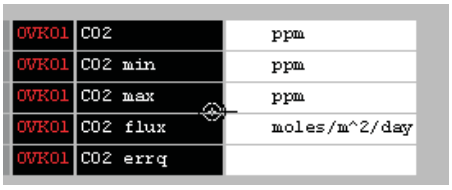
Scada software suite

Scada application

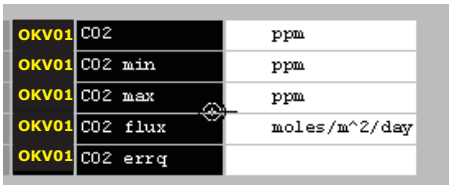
The StationID field backcolor and forecolor change in function of the status of the call.



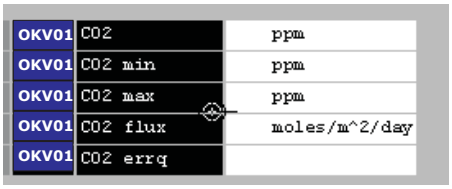
Green, Black:
Scada is calling the station;



Black, Red:
Scada was not able to reach the station: The remote telemetry is off / the telemetry is not working ;



Black, Yellow:
Scada was able to reach the station, but the station is not answering correctly;



Blue, White:
Scada was able to reach the station and get the data; This mus be the "normal" situation when Scada is waiting the next call.

Scada software suite

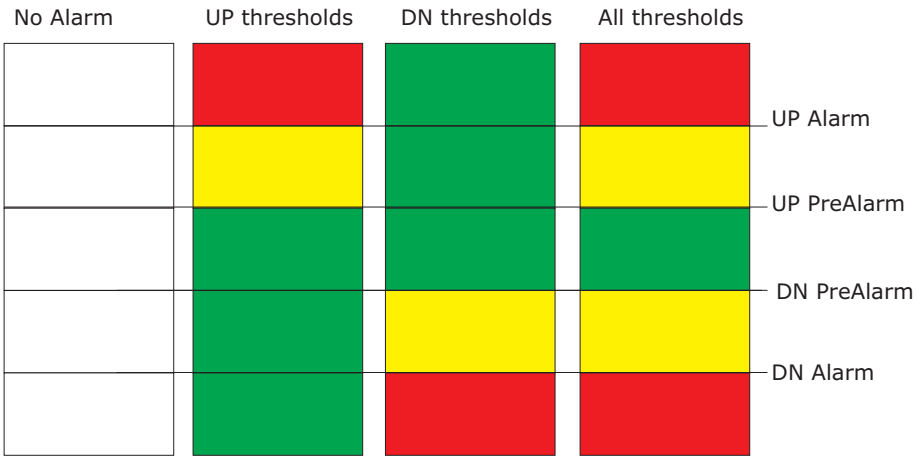
Scada application

Scada software suite

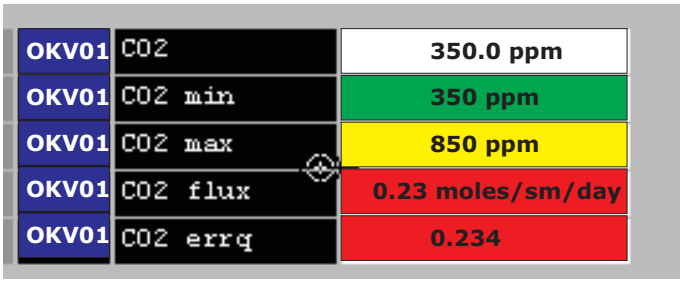
Scada application

The alarms

For each channel is possible to set an alarm:



The alarm management will modify the backcolor of the result field of the channel in order to highlight when a value is not "correct"



The channel result field backcolor can be:

WHITE : if the channel has not alarms configurated. All the values are considered OK;

GREEN : The channel has alarms configurated and the value is in the normal range;

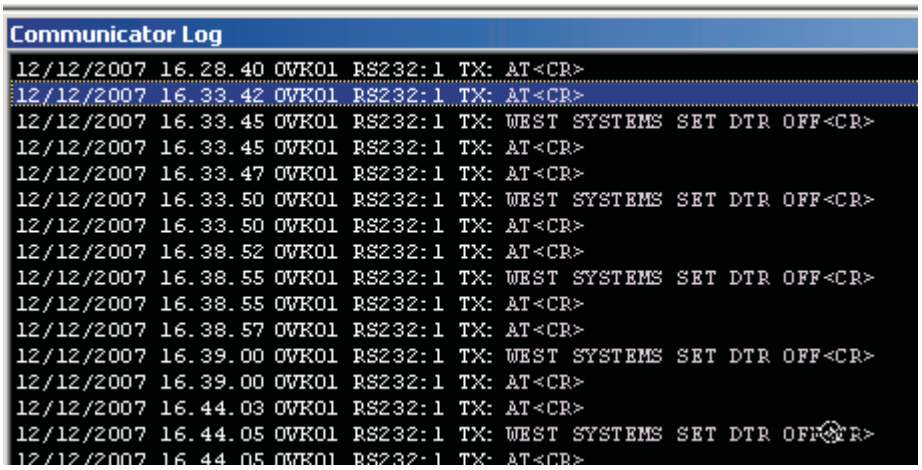
YELLOW: The channel value is between the prealarm and alarm thresholds;

RED: The channel value higher than the UPalarm threshold (Or is less than the DNAlarm one);

Scada software suite

Scada application

In the lower right corner a dialog shows the "binary" communication that flows on the coomunication stream between computer and telemetry device:



Some of the byte are "translated" in a visible format: for example the byte &0D (That correspond to the Enter key) is diplayed as <CR>.

The format is:

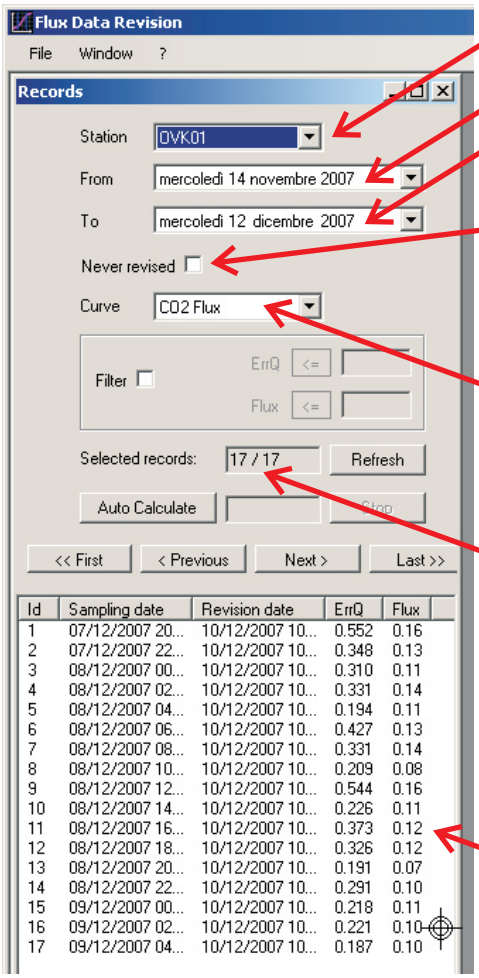
dd/mm/yyyy hh:mm:ss : 12/12/2007 16.28.40
stationID : OVK01
TelemetryType : RS232
Communication port: 1
Direction of communication: TX (or RX)
Trasmitted data: AT<CR>

The communication log can be saved on a text file by right clicking on the text box and selecting {Save as}.

Scada software suite

Flux revision

Fluxrevision allows the checking of flux curves acquired by the station.



Select your station.

Select the initial date of the period.

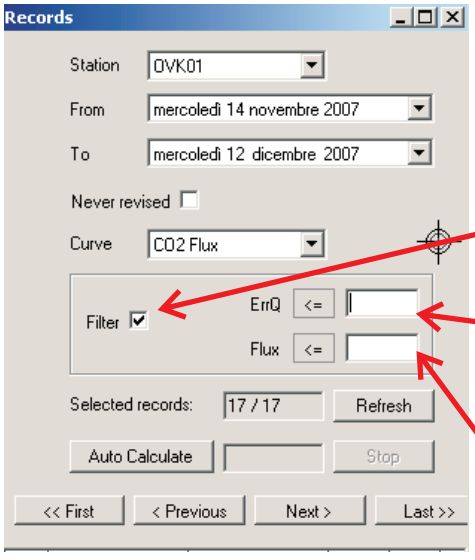
Select the end date of the period.

By selecting "Never revised" you can select the curves you never checked

Select the gas specie (If the station has additional gas detectors)

Number of selected curves / Total number of curves in the query period.

The list of flux curves that correspond to your selection



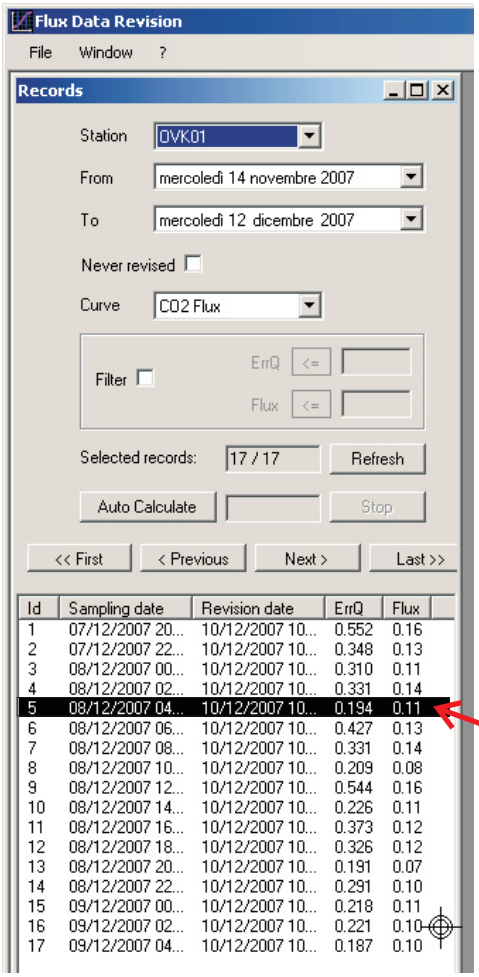
By selecting [Filter] you can apply a more restrictive filter to your query.

ErrQ <= 0.9 will select the curves where ErrQ is less than 0.9 (That means not very well shaped curves).

Flux >= 1500 Moles/sm/day will select the curves where the flux is more than 1500 moles/sm/day (That means exceptionally high flux).

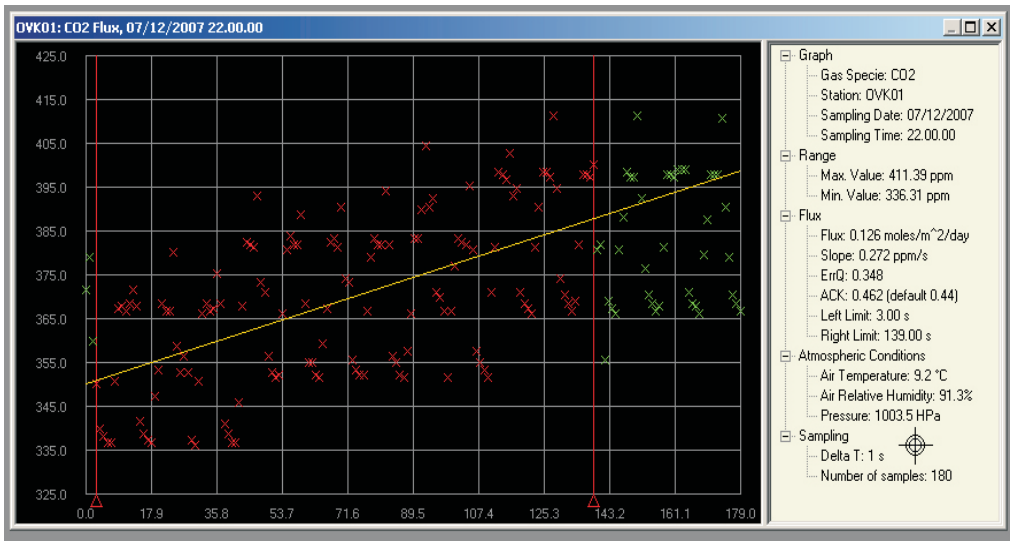
Scada software suite

Flux revision



To see the flux curve click on the list.

The flux curve



On the right part of the form is reported the information related with the flux curve.

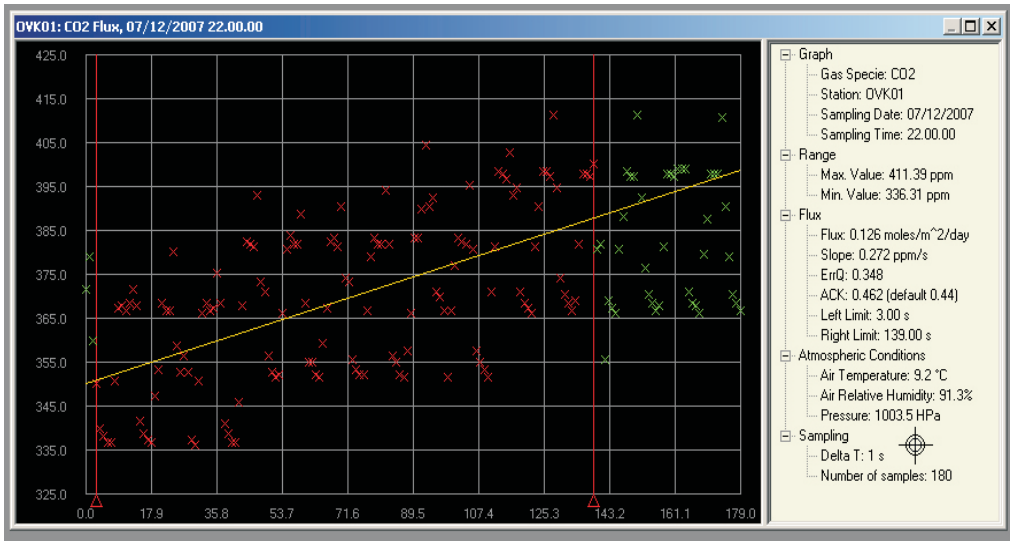
The interval used to compute the regression is highlighted in red.

The regression computed is drawn in yellow.

The limit of the interval are the two red vertical lines.

Scada software suite

Flux revision

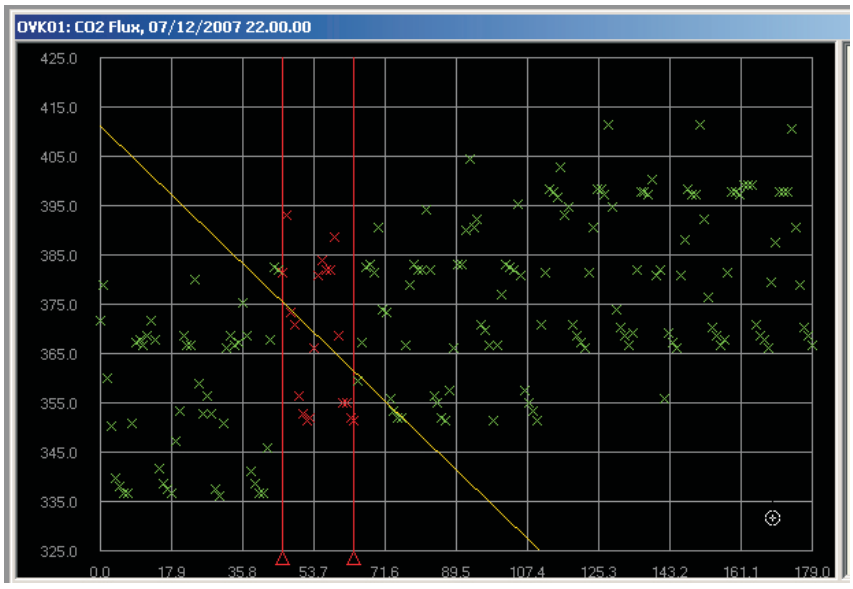


Manual revision

Modify the limits by dragging the vertical lines in the desired position.

The flux, the slope and the ErrQ will be automatically updated.

To save the new result right clik and select {Save Flux}



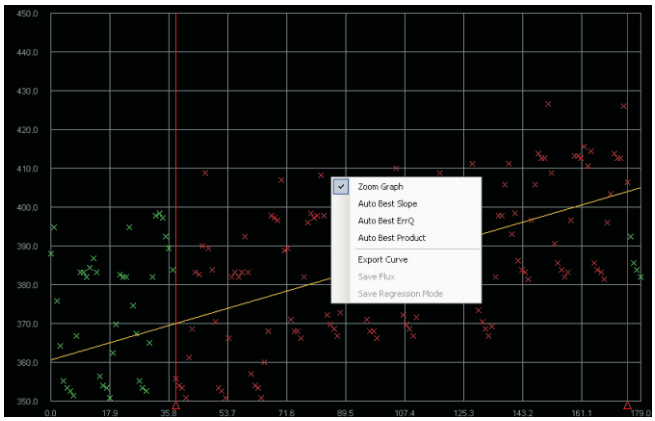
Using the manual revision the computation of flux is completely under your responsability. You can select wrong interval and get wrong results, as in the drawing.

The slope of the curve is positive, but the seleted interval, too short, gives a negative result.

Scada software suite

Flux revision

Automatic computation of flux.



FluxRevision can compute the flux following 3 different algorithms:

By selecting {Auto Best slope}: the flux will be computed searching for the higher flux;

By selecting {Auto Best ErrQ}: the flux will be computed searching for the better regression quality;

By selecting {Auto Best Product}: the flux will be computed searching for a compromise between higher flux and best regression quality.

After the automatic computation you have to select {Save Flux} to save the results.

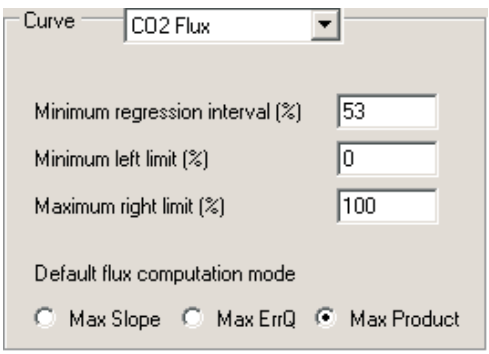
The automatic computation uses, as minimum interval to be used, the interval selected by left and right limits (The two red vertical linees), then if you want to compute the flux using at least 50% of the points in the curve you've to select approximately the 50% of the curve and after select one of the 3 methode for the auto computation. After that you've to select {Save regression mode} to save this settings.

The saved settings will be used by the batch processing of FluxRevision and by Scada, when it process the curves while downloading for the station.

Batch processing

By pressing the [Auto Calculate] button fluxrevision will process all the fluxcurves in the list. The methode and the minimum interval will be the one selected with the procedure described before.

More restrictive settings to the automatic processing can be set by opening the {File}{Settings} menu.

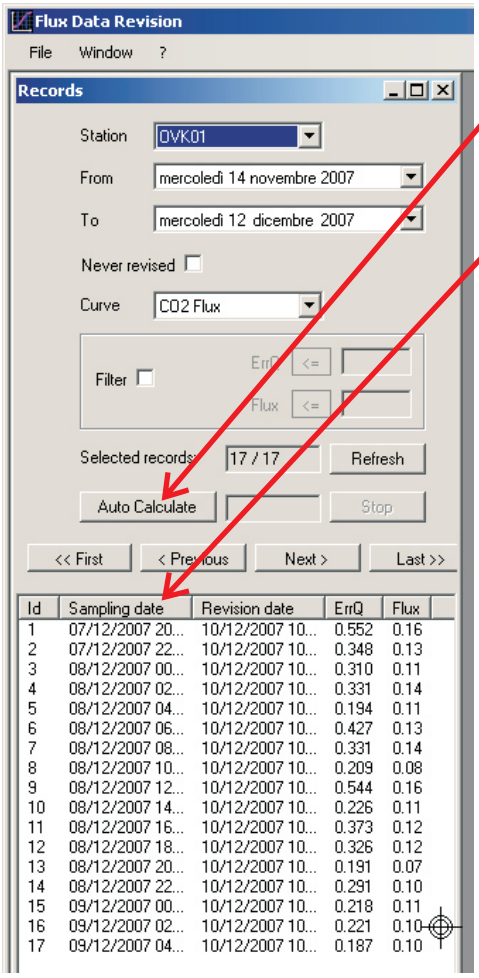


For each gas specie you can set the minimum interval, the minimum left limit and the maximum righ limit, as well as the processing algorithm.
If you need a rigid processing you can set rigid parameters as:

Interval : 80%
Minimum left: 10%
Maximum right:10%
With these settings Scada and Flux revision are obliged to compute the flux in the range from 10% to 90% of the curve.

Scada software suite

Flux revision



Batch processing

By clicking on [Sampling Date] you can order the list by date in ascending or descending mode .

same consideration for the Revision date, the ErrQ and the Flux.

Scada software suite

Monitor

Monitor is a simple application designed to have a quick view of the last days of data.

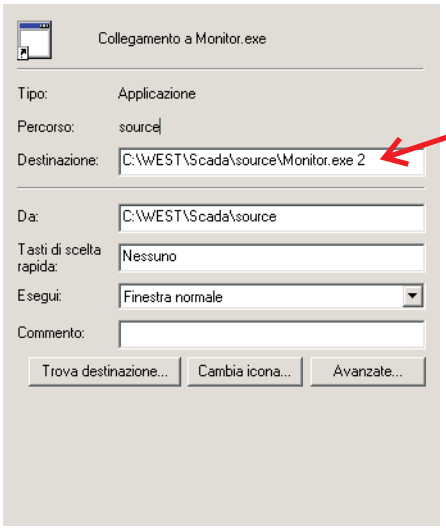
Monitor display the data of the channels that are active and have the field *Channels.Monitored* > 0 and the *Channels.MonitoringGroup* = 1;

The field Channels.MonitoringGroup can be used to assign a group of channels to a specific instance **Monitor**

To have two Monitor, one showing a group of channels and the second showing a second group of channels you've to:

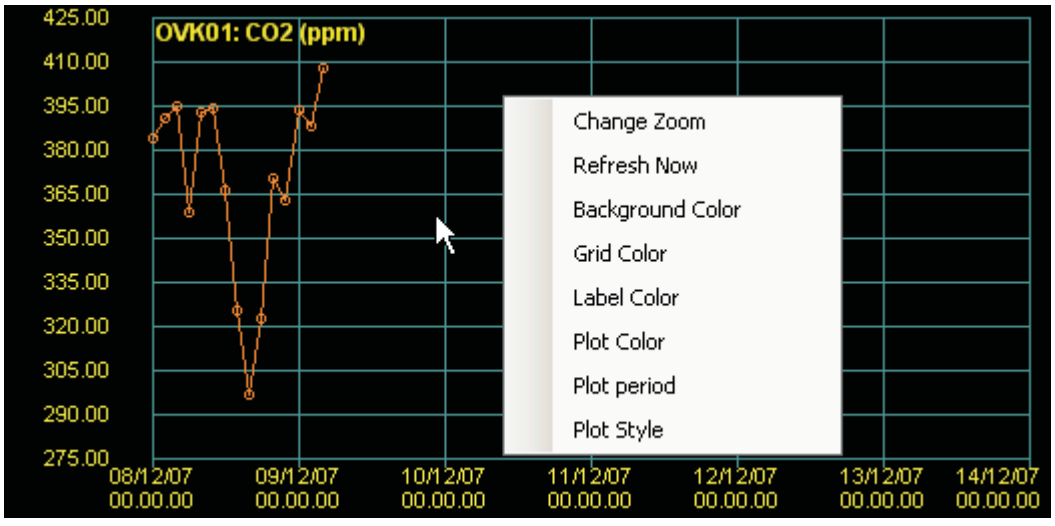
1) Open the *Channels* table of *scada_data.mdb* , put the value 2 on the *Channels.MonitoringGroup* of the channels you want to assign to the second group.

2) Create a new ShortCut of Monitoring and modify the properties of the shortcut as following:



Monitor apparence

By right clicking on the screen you can modify the apparence properties of each plot, as the color of the grid, the background....

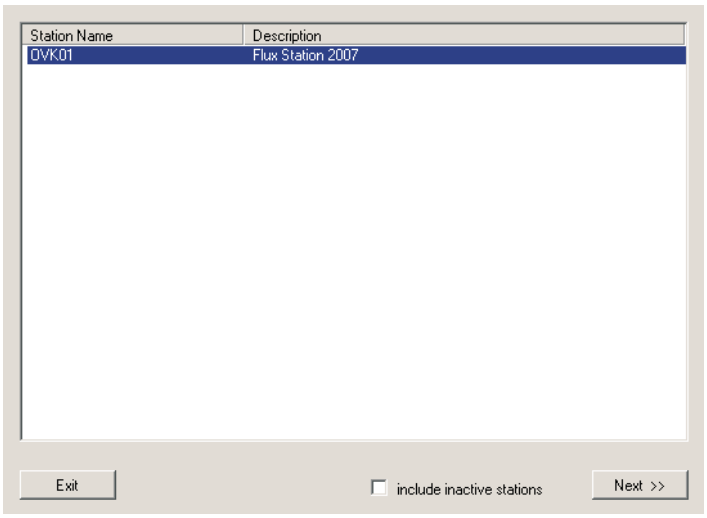


Scada software suite

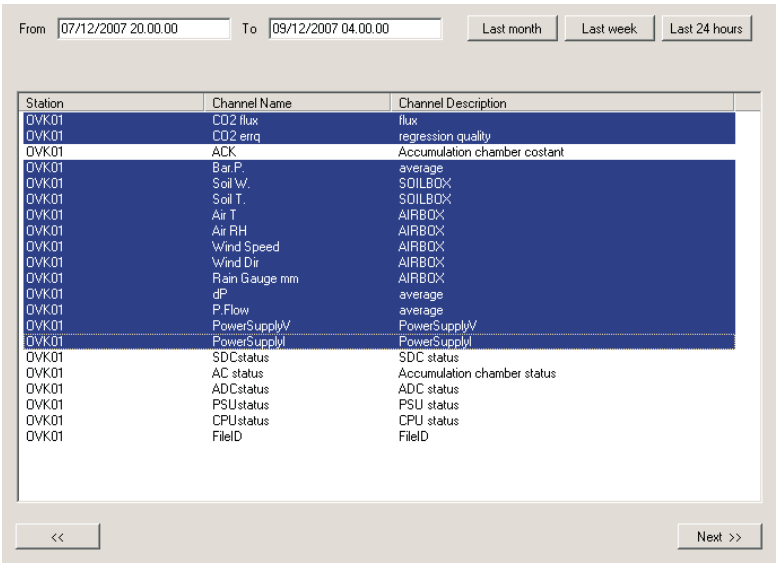
Query

The Query application allows you to exctract the data from the database and to put it an a table in the MS Excel format

Run **Query** and selct the station(s) you want to query.



Press the [Next >>] button.

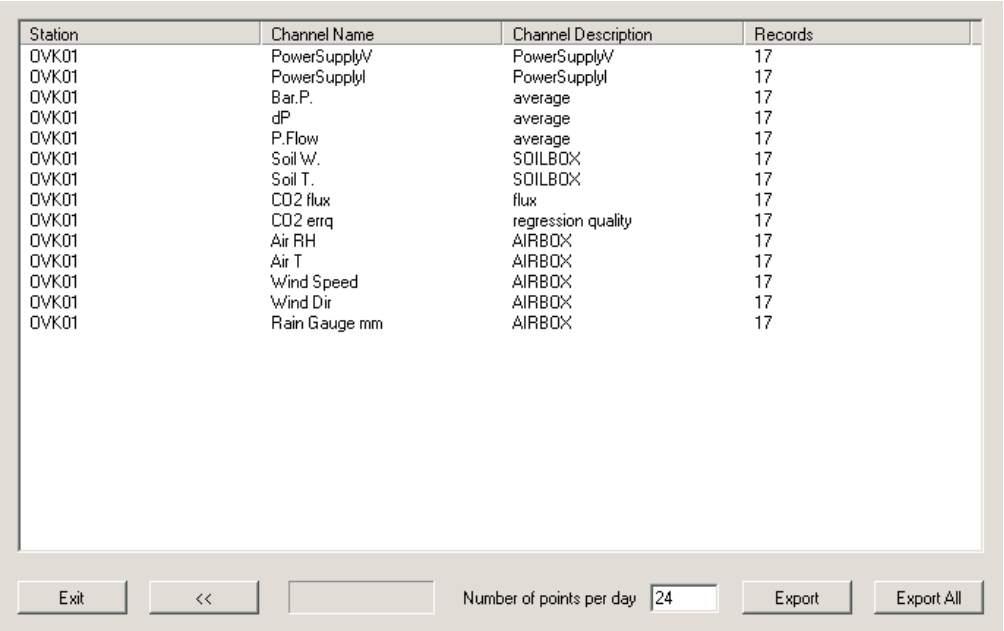


Set the date interval you want to query and Select the Channels then press [Next >>];

The buttons [Last month], [Last week] [Last 24 hours] will help you by setting a "standard" time interval.

Scada software suite

Query



Station	Channel Name	Channel Description	Records
OVK01	PowerSupplyV	PowerSupplyV	17
OVK01	PowerSupplyI	PowerSupplyI	17
OVK01	Bar.P.	average	17
OVK01	dP	average	17
OVK01	P.Flow	average	17
OVK01	Soil W.	SOILBOX	17
OVK01	Soil T.	SOILBOX	17
OVK01	CO2 flux	flux	17
OVK01	CO2 errq	regression quality	17
OVK01	Air RH	AIRBOX	17
OVK01	Air T	AIRBOX	17
OVK01	Wind Speed	AIRBOX	17
OVK01	Wind Dir	AIRBOX	17
OVK01	Rain Gauge mm	AIRBOX	17

A resume of the query is reported: The column "Records" shows how many record are present in the time interval you selected for each channel;

By pressing [Export All] you'll get a table with a row for each record (and a column for each channel, plus one for the date/time);

By setting the "Number of points per day" field, for instance putting 4, and pressing [Export] you'll get a table with the 4 row for each day. This feature is useful when you need a simplified table that reports, for example, only the daily average of each chanell.

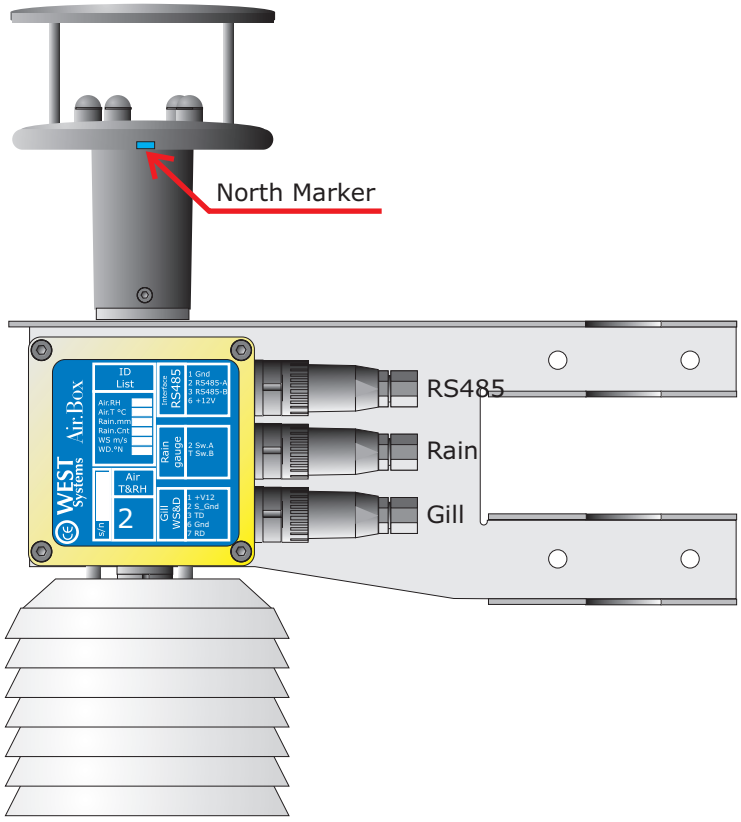
After pressing the button you've to choose a name and a folder for the excel file .

AirBox

Release II , General description

The air box is an hardware/software interface that convert the signal of Air Temperature/ Relative Humidity gauge and Sonic wind speed / direction gauge to a digital format compatible with the DF1A soilflux station.

The output of the air box is a RS485 with the standard WESTS Systems pin out. Since the AirBox is designed to be the last device in the bus the RS485 line is terminated with a 120 Ohm embedded resistor.



Description	Conf	Unit	Sw6 Off	Sw6 On
Rain Gauge	DF	mm	**A8**	AD
Wind direction	D8	°N	**A7**	AC
Wind Speed	D7	m/s	**A6**	AB
Air Temperature	D9	°C	**A5**	AA
Air rel.humidity	DA	%	**A4**	A9

The air box is designed to be mounted on a 50 mm diameter pole. Avoid obstacles that can affect the wind speed and direction measurement accuracy.
The blue marker must be pointed in NORTH direction, using a compass, to get the correct reading of wind direction.

The rain-gauge must be levelled using the bubble gage

AirBox

Connectors pinout

GILL Connections

Panel 6+T female connector			PCB Pin	
Pin 1:	+V12	RED	5)	+12V
Pin 3:	SGND	Green	8)	Gnd
Pin 5:	TD	Yellow	7)	RD
Pin 6:	Gnd	Black	8)	Gnd
Pin 7 (T):	RD	Blue	6)	TD

Air RH & T Connections

Panel 6+T female connector			PCB Pin	
Pin 2:	+5V	Red	9)	+5V
Pin 3:	Data	Yellow	11)	Data
Pin 5:	Sck	Blue	10)	Sck
Pin 6:	Gnd	Black	12)	Gnd

Rain Gauge Connections

Panel 3+T male connector		PCB Pin
Pin 2:	SW_A	13)
Pin T:	SW_B	14)

RS485 Connections

Panel 6+T male connector			PCB Pin
Pin 1:	Gnd	Black	4) Gnd
Pin 2:	A	Yellow	1) A
Pin 3:	B	Green	2) B
Pin 6:	+V12	Red	3) +Vin

DIP switch settings

SW1	Air RH%	**On**
SW2	Air T.°C	**On**
SW3	W.Speed m/s	**On**
SW4	W.Dir °N	**On**
SW5	Rain G.	**On**
SW6	ID Base/Extended	**On**
SW7	Set Conf=05	Off
SW8	Calibration enabled	Off

SW7 : If your station firmaware is older than release 9.14 please set SW7 to ON in order to allow the correct configuration of the RS485 chain. You can read the firmware release of the station resetting it. (Power off, wait at least 10 seconds and power on the station).

SW6: If two airbox are installed on the same RS485 chain the SW6 switch of one of them must be set to On in order to avoid addresses interference.

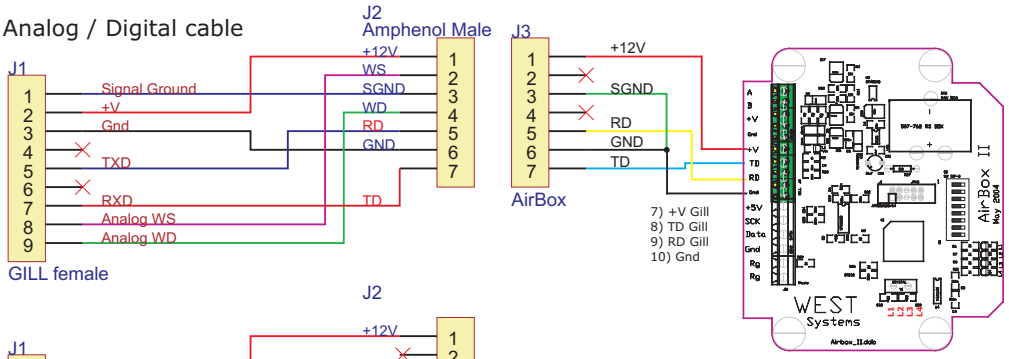
SW8: No actual user enabled function

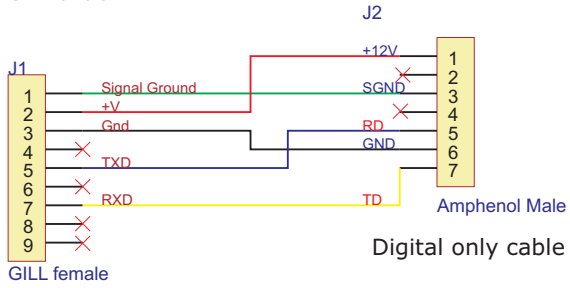
Gill sonic wind speed and direction gauge

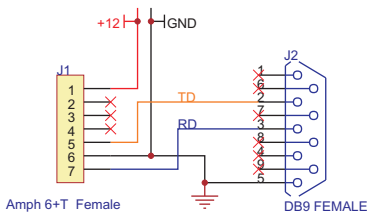
Speed
- Range 0..60 m/sec
- Accuracy : 4%
- Resolution : 0.01 m/sec

Direction
- Range 0..360 degree North without dead zone.
- Accuracy : 3%
- Resolution : 1 degree

Power supply
- 9..30 VDC 40 mA typical @ 12VDC







Gill configuration
M2 Gill Polar Continuous data format mode
U1 WInd Speed Unit meter/second
O1 Comma Separated Format CSV
L1 CR/LF Message terminator
P1 Out rate 1 sample / second
B3 Baud rate 9600
F1 No parity 8 bit
H1 Power-up message on
NQ Node address not defined
E3 communication protocol E3 = RS232

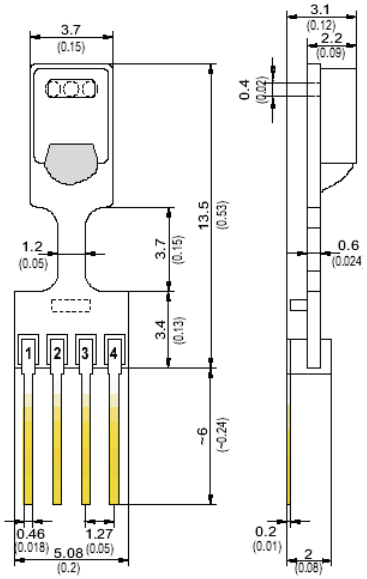
If analogue output is present:
S6 = 0-60 m/sec Wind Speed analogue range output
C2 = Wrap around 0-359°
T1 = 0..5 Volts analoge voltage output (T2=4-20mA)

To configure the GILL connect it via RS232 using a 9600-n-8-1 configured terminal.
Send a "*" to enter in the set mode and D3 to list the actual settings.
Send a
E3<Enter>
and check it sending an
E<Enter>

Turn off the GILL, wait 5 second and turn on it.
Enter * and D3 to check that the configuration changed.
The GILL save the modifications automatically

AirBox

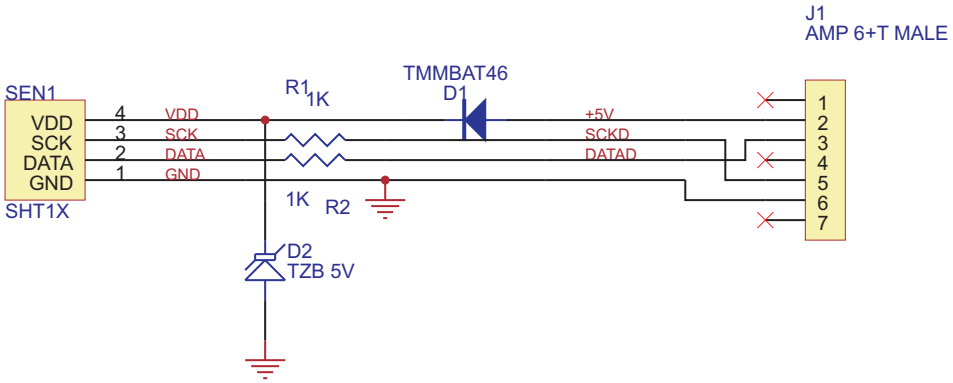
Silicon Air Temperature and relative humidity gauge



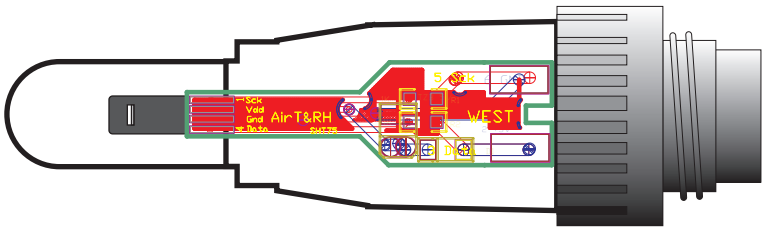
Sensor specifications

2 sensors for relative humidity & temperature
- Measurement range: 0-100% RH
- Absol. RH accuracy: +/- 2% RH (10...90% RH)
- Repeatability RH: +/- 0.1% RH
- Temp. accuracy: +/- 0.4°C (5...40 °C)
- Calibrated & digital output
- Fast response time < 3 sec.

Probe schematics



Probe Layout (actual size)

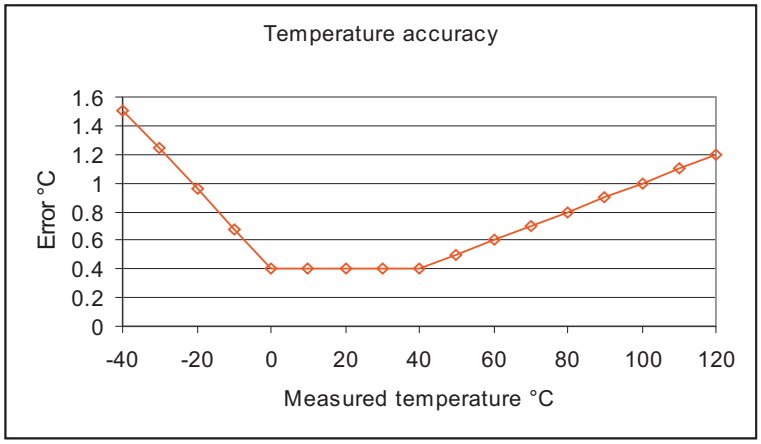


Amphenol 6T male

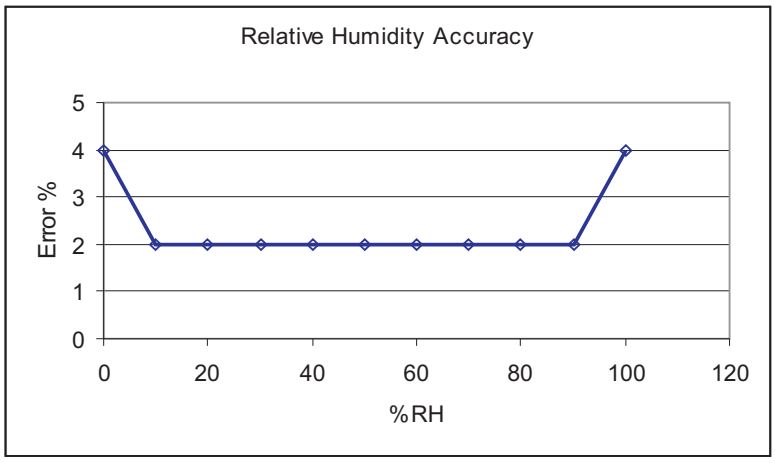
AirBox

Silicon Air Temperature and relative humidity gauge

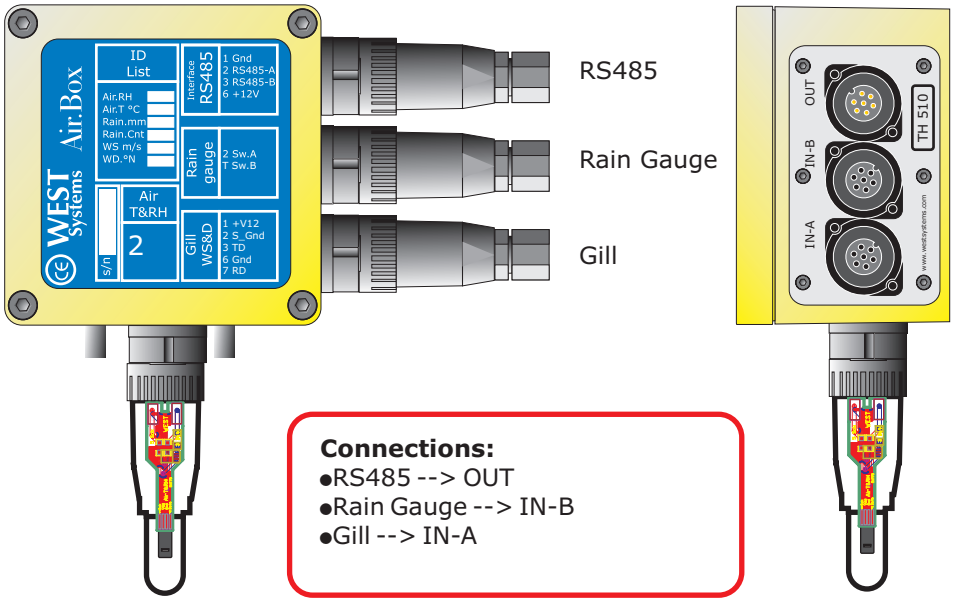
Air Temperature accuracy Vs. temperature



Relative Humidity accuracy Vs. RH%



AirBox



Connections:
- RS485 --> OUT
- Rain Gauge --> IN-B
- Gill --> IN-A

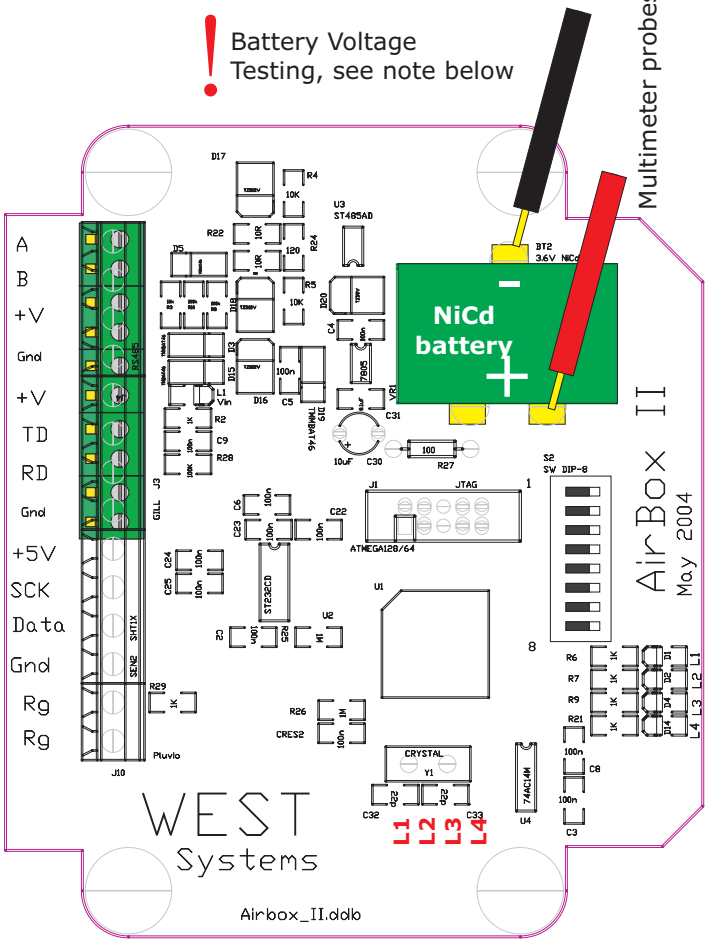
Air TH & T. Probe

PCB Layout

1) RS485_A
2) RS485_B
3) +V in
4) Ground
5) Gill +12V
6) Gill TD
7) Gill RD
8) Gill Gnd
9) Ss +5V
10) Ss SCK
11) Ss Data
12) Ss Gnd
13) Rg Sw.A
14) Rg Sw.B

! Battery Voltage Testing, see note below

Multimeter probes



! The correct working of RAIN gauge, when the station is in stand-by, is substained by the internal NiCd battery. To allow the proper operation of the system the battery voltage must be more than 4.6 Volt.
To test it:
1) power off the station;
2) measure the NiCd battery voltage;
3) drop 100 cc of water inside the RainGauge: the 4 LED lights must Flash for a 1/5 second period per each raing gauge balance "click".

Rain gauge

Manufatcurer : LASTEM
Ordering code :DQA030
Rain gauge
Range: illimited . . . .
Accuracy 1%
Resolution 0.2 mm
Collector surface area: 324 square centimeter
Collector area diameter : 203 mm
Temperature range 0..+50°C

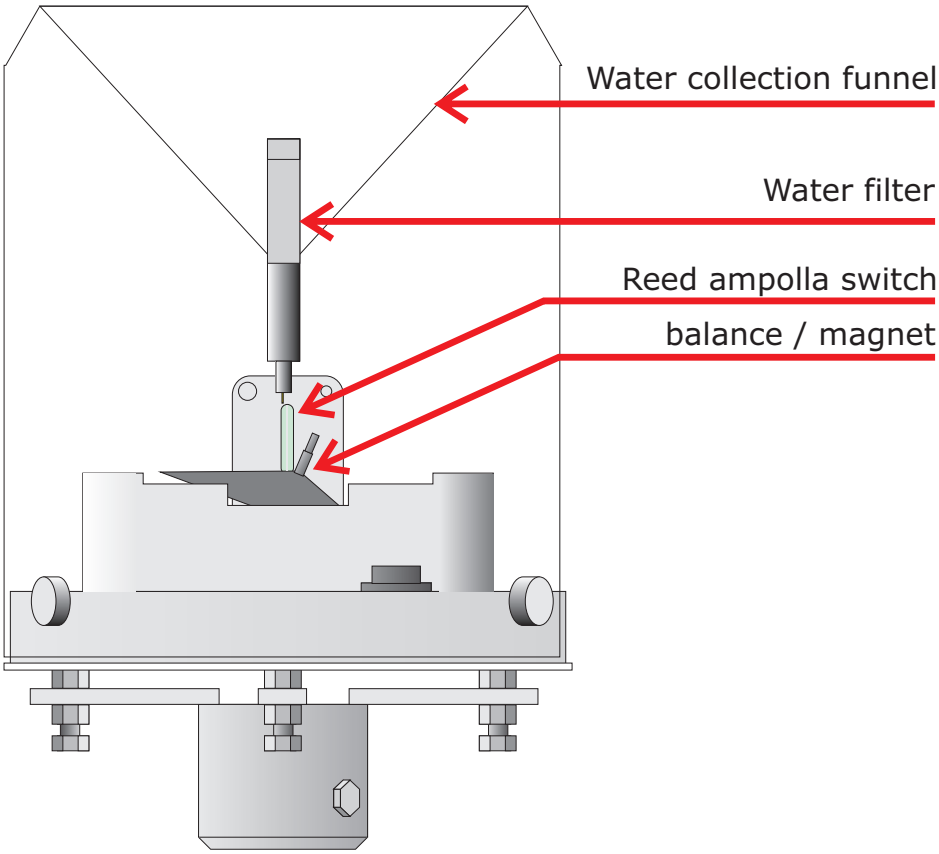
Rain gauge support for 50 mm diameter mast mounting

AirBox

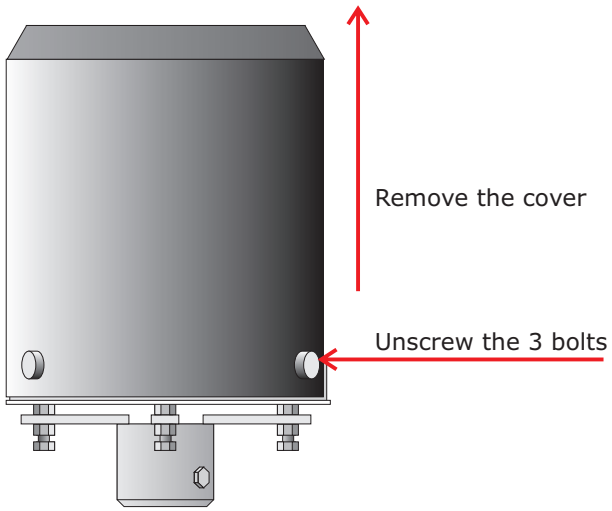
While the FluxStation is in stand-by state the airbox reads and store the reading of the raingauge. The airbox is power supplied with a 3.6V rechargeable battery that's charged by the FluxStation every analisys cicle.

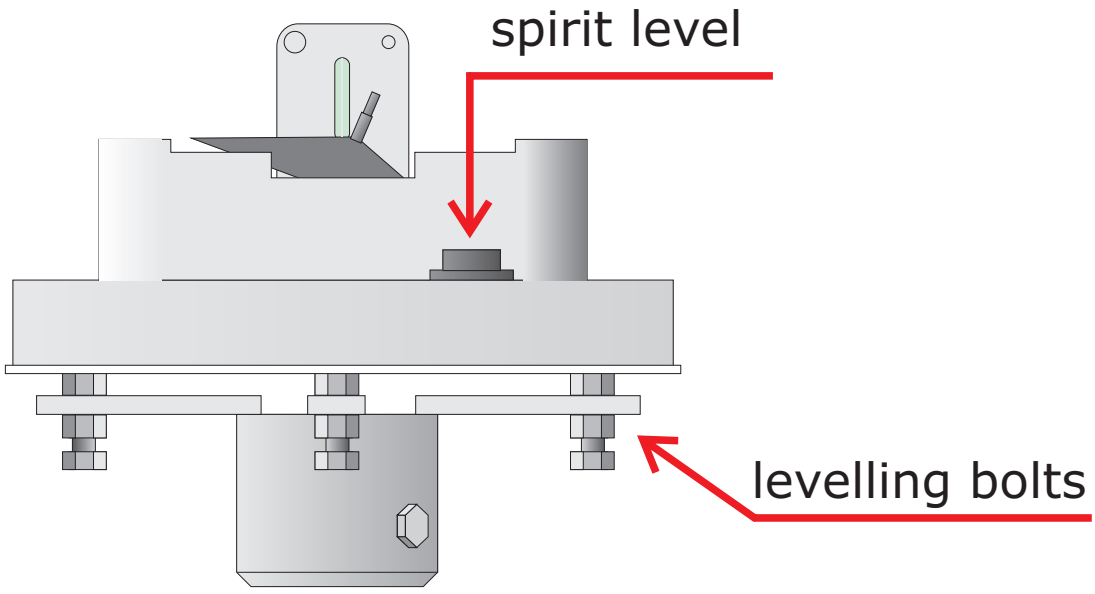
Check

To check the calibration of the raingauge:
Enter, slowly, 1.0 liter of water in the funnel. The reading must be increased of 30.8 mm.
Since the rain gauge channel reading is cumulative, you've to note any test you made, in order to do not confuse tests with real rain.



Rain gauge





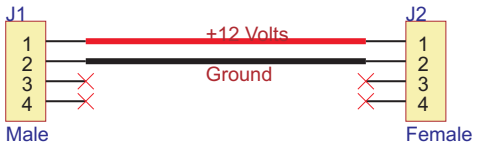
In order to have a correct working the raing-gauge must be levelled by trimming the 3 levelling bolts. A spirit-level will help in the levelling.

Cables

Power supply cable

J1 Amphenol 3 + T Pin Male

J2 Amphenol 3 + T Pin Female



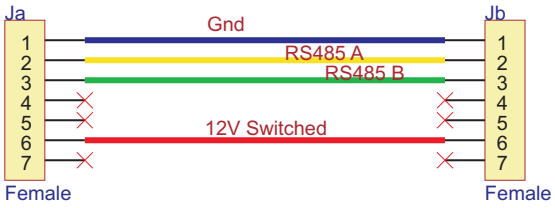
Solar cell cable

J3 Amphenol 3 + T Pin Female

RS485 cable

Ja Amphenol 6 + T Pin Female

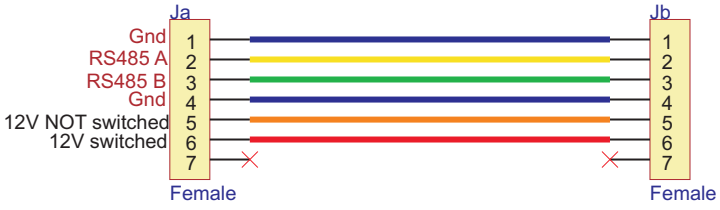
Jb Amphenol 6 + T Pin Female



RS485N cable

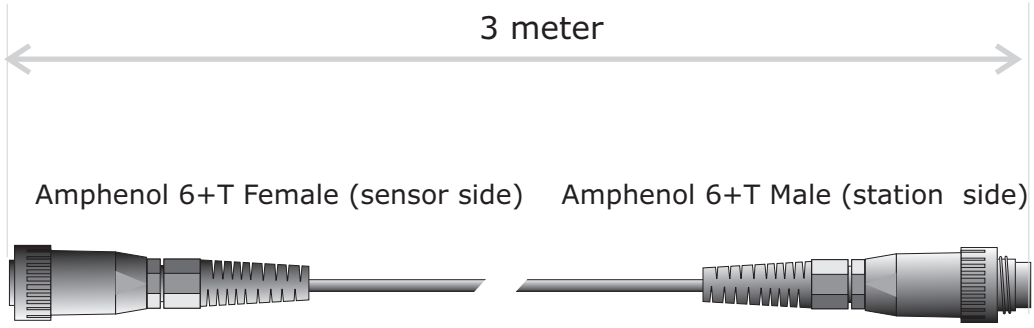
Ja Amphenol 6 + T Pin Female

Jb Amphenol 6 + T Pin Female



Cables

Standard analog sensor cable



Pin 1 12 Volts
Pin 2 Channel A signal
Pin 3 Signal GND common
Pin 4 Channel B signal
Pin 5 n.c.
Pin 6 Gnd (power ground)
Pin 7 n.c.

Connectors Amphenol Part Numbers

```
Amphenol 6+PE female cable Amphenol T3105-001
Amphenol 6+PE male   cable Amphenol T3104-001
Amphenol 3+PE female cable Amphenol T3109-001
Amphenol 3+PE male   cable Amphenol T3108-001

Amphenol 6+PE female panel Amphenol T3107-000
Amphenol 6+PE male   panel Amphenol T3106-000
Amphenol 3+PE female panel Amphenol T3111-000
Amphenol 3+PE male   panel Amphenol T3110-000

Amphenol PLUG for female   Amphenol T6482-000
Amphenol PLUG for male     Amphenol T6483-000
```

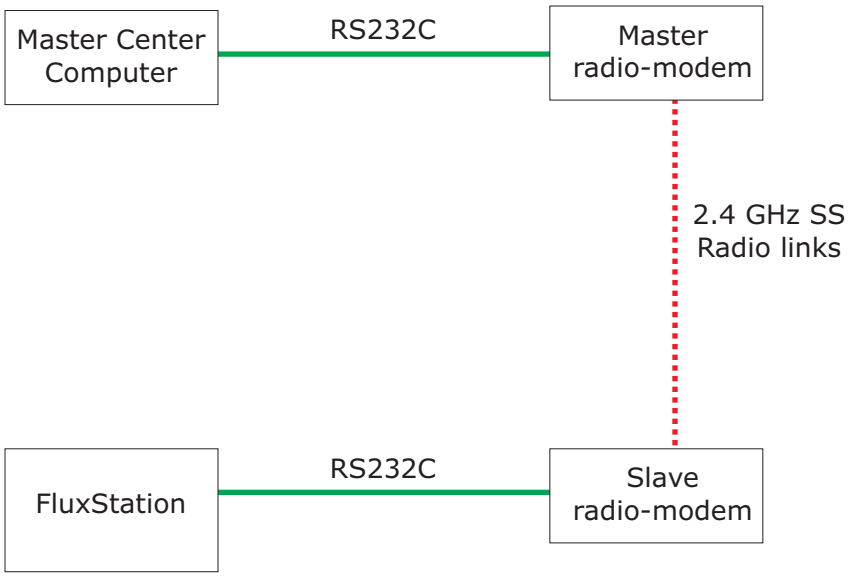
SpreadSpectrum 2.4 GHz radio telemetry

Global system block scheme.

The system described in this handbook is a data trasmission system able to transfer bidirectional data between two RS232 based equipments.

The system is composed by 2 radio-modems, 2 antennas, and several accessories.

In the following drawing a sketch of the system is shown.



The maximum range of "radio link" is approximately 35 Km (20 miles) in optimal conditions. The two antennas of each radio link must be optically visible in a licteral mode. Rain, storms, high air humidity as well as snow and tree leaves can reduce drastically the range. The antennas must be installed in the most elevated position in order to improve the radio signal quality.

The system can works as
Point to Point Master mode 0
or
Point to Point switched Master mode 6

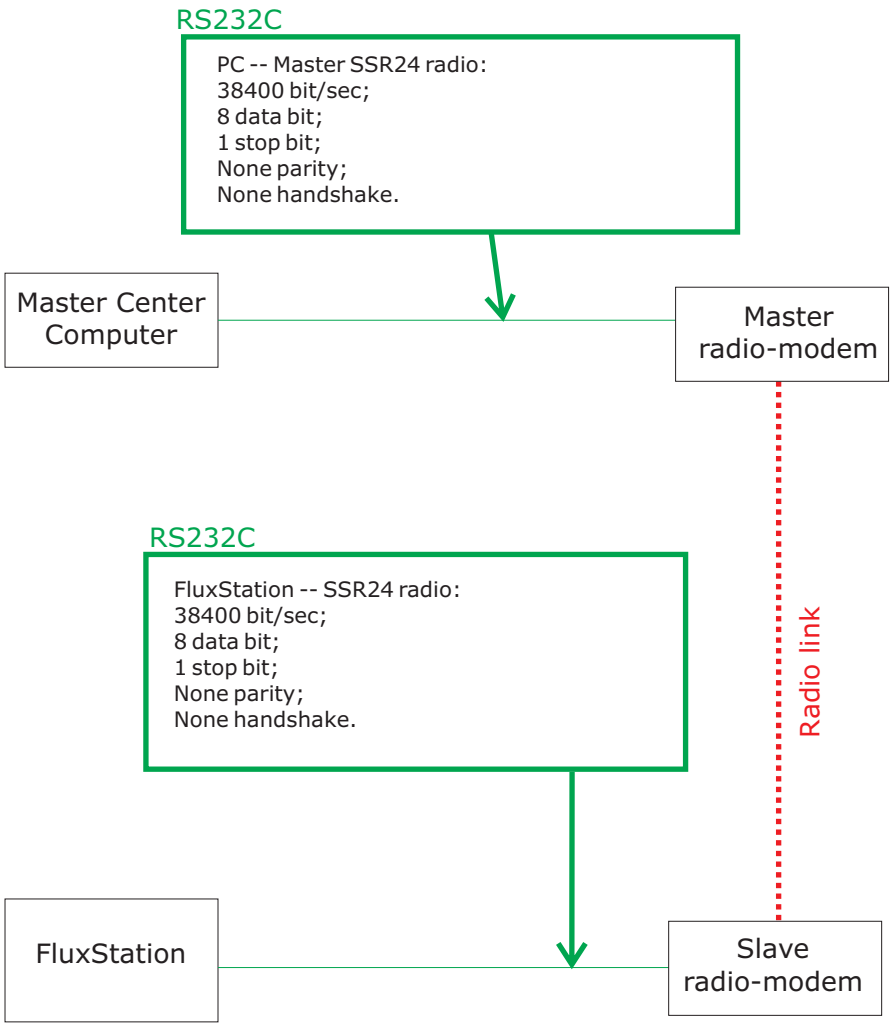
The factory setting is MODE 0 : point to point

To change from mode 0 to mode 6 some modification in the setup of Master radio is necessary, as well as modification in the scada_data.mdb file.

SpreadSpectrum 2.4 GHz radio telemetry

Point to point telemetry system

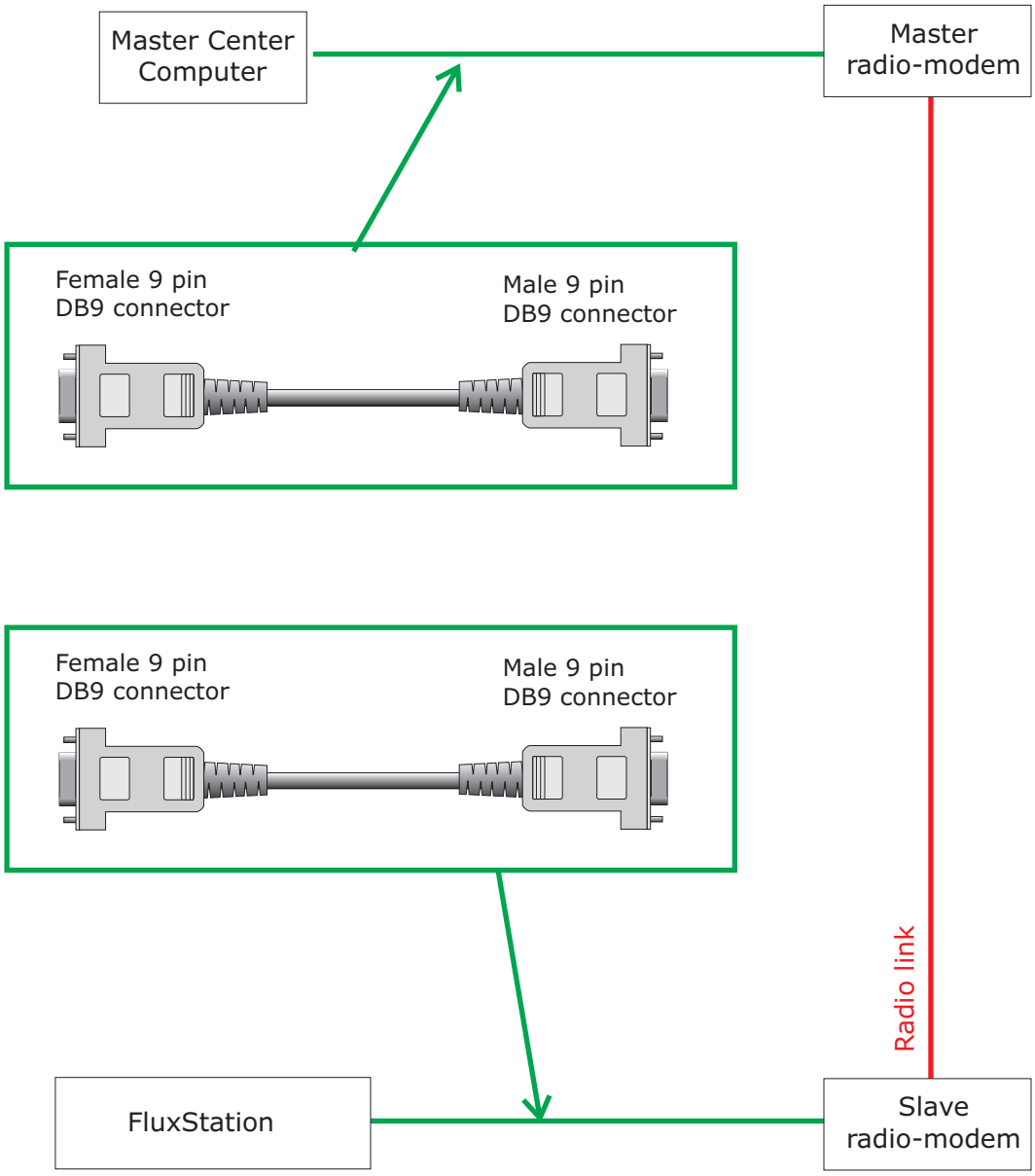
The system is set to trasmit data bidirectionally from the master center up to the remote equipment:
Due to the specification of the FluxStation the maximum effective connection rate is limited to 38400bit/sec.



SpreadSpectrum 2.4 GHz radio telemetry

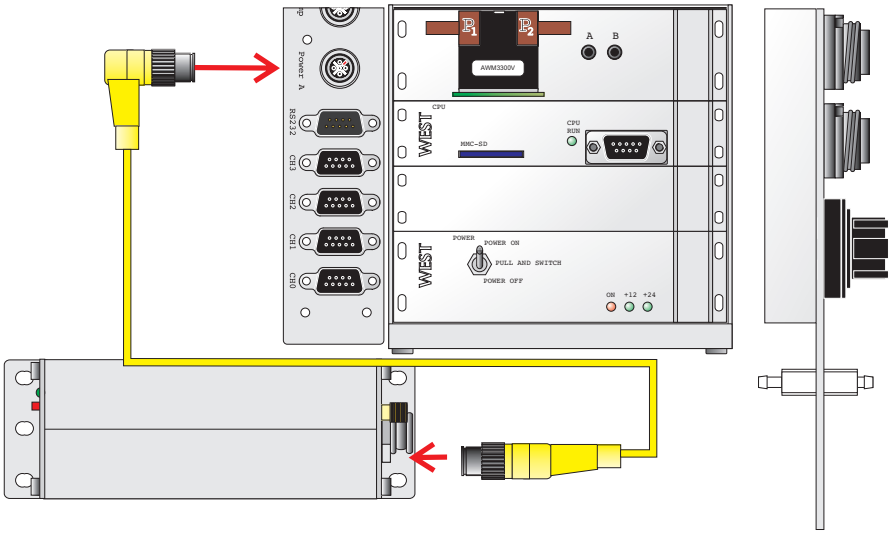
Point to point telemetry system

RS232 cabling specifications



SpreadSpectrum 2.4 GHz radio telemetry

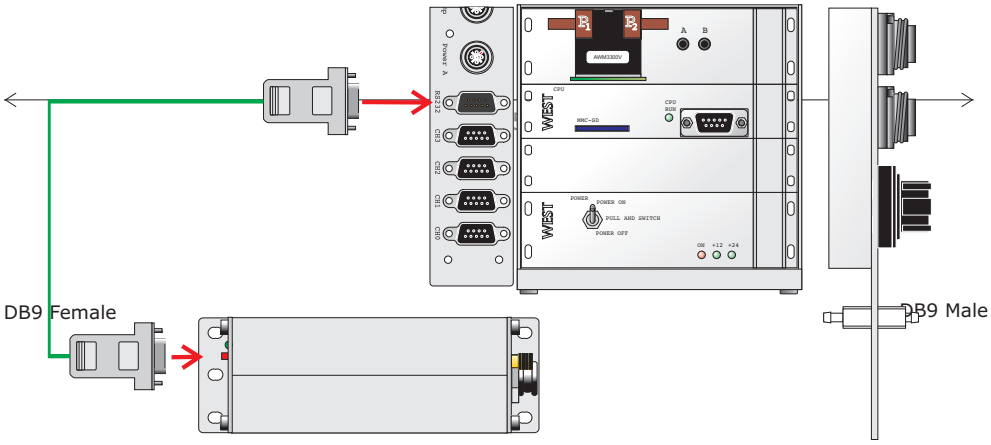
Connecting telemetry to the station



Connect the power supply cord of radio to "Power A"

RS232 cable

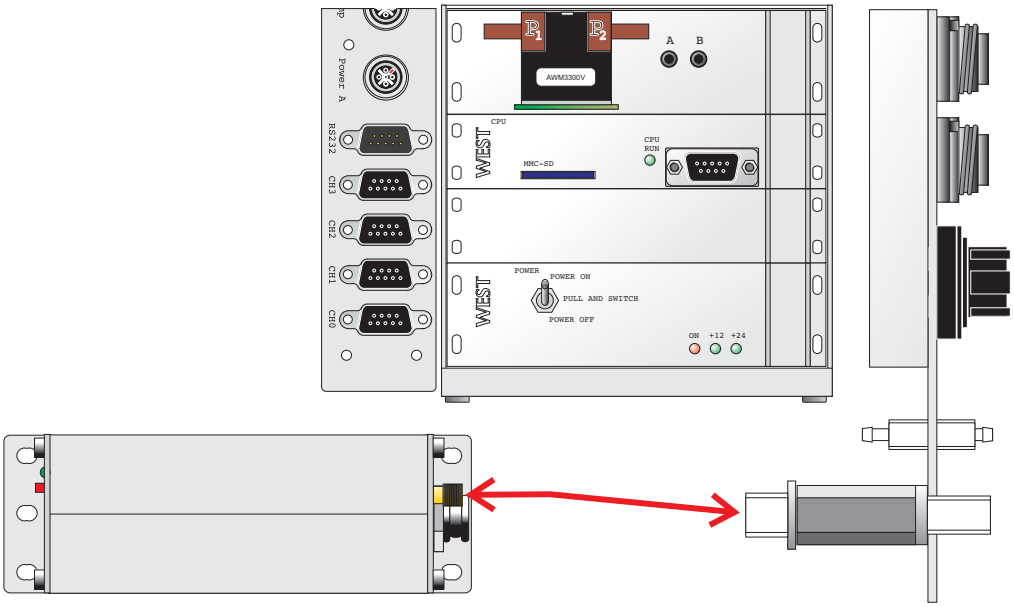
9 Pin Female to 9 pin male Pin To Pin RS232 cable:



Connect the radio RS232 to the fluxstation RS232

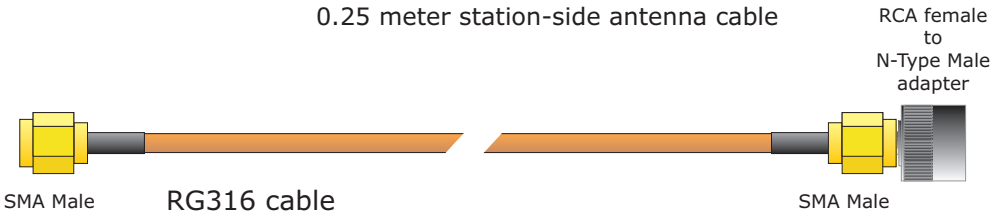
SpreadSpectrum 2.4 GHz radio telemetry

Connecting telemetry to the station



Connect the antenna out of radio to the pass-trough connector

RF Radio pig-tail



We supplied two ruggedized BackFire 18 db antennas. The antenna can be polarized in both , vertical or horizontal polarization. By default the antennas are set to the vertical polarization.

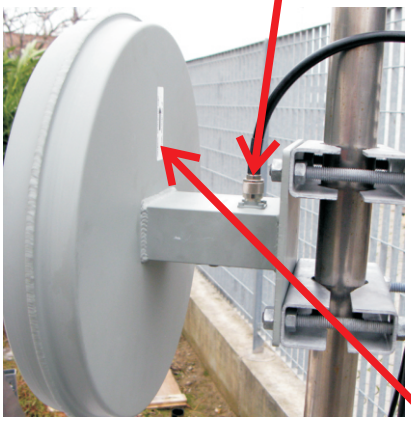
For the master center we supplied a 10 meter lenght coaxial cable.

SpreadSpectrum 2.4 GHz radio telemetry

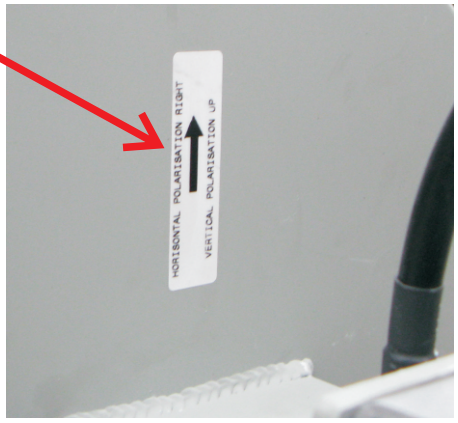
Connecting the antenna to the station

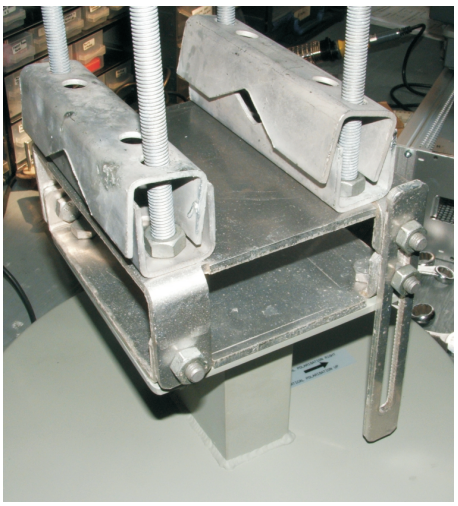
Connect the coaxial cable to the passtrought connection on the right panel of FluxStation.

Protect the connector with **self-bolding** tape.



Pay attention to antenna polarization (Vertical in the picture).





The antenna is furnished with a tilt adapter to point the antenna in the vertical plane. Due to space problems the tilt adapter must be assembled by you.

SpreadSpectrum 2.4 GHz radio telemetry

Setting the radio-modem

Change the setting of the radio-modem only when strictly necessary.

- Connect the radio-modem to a computer using a standard serial cable;
- Open a RS232 terminal , hyperterminal for example;
- Set the software to 19200 , 8 data bit, 1 stop bit , none parity , none (or hardware) handshake;
- Press the SET red button on the front panel of radio modem: All the LED light (CTS,TX,RD) on the radiomodem panel will become solid GREEN;
- Follow the instruction reported on the handbook to change the setting;

Here following the default (WEST Systems) factory settings for each radio-modem.

Master radio-modem

Modem Serial Number 242-6476
Point to Point Slave/Master Switchable

SET MODEM MODE Modem Mode is 0

(0) Point to Point Master
(1) Point to Point Slave
(2) Point to MultiPoint Master
(3) Point to MultiPoint Slave
(4) Point to Point Slave/Repeater
(5) Point to Point Repeater
(6) Point to Point Slave/Master Switchable
(7) Point to MultiPoint Repeater
(F) Ethernet Options
(Esc) Exit to Main Menu

SET BAUD RATE
Modem Baud is 38400

MODEM CALL BOOK
Entry to Call is 00
Entry Number Repeater1 Repeater2
(0) 242-7581
(1) 000-0000

RADIO PARAMETERS
(0) FreqKey 5
(1) Max Packet Size 8
(2) Min Packet Size 9
(3) Xmit Rate 1
(4) RF Data Rate 3
(5) RF Xmit Power 10
(6) Slave Security 1
(7) RTS to CTS 0
(8) Retry Time Out 255
(9) Lowpower Mode 0
(A) High Noise 0
(B) MCU Speed 0
(C) RemoteLED 0

SET BAUD RATE
Modem Baud is 038400
(A) Data, Parity 0
(B) MODBus RTU 0
(C) RS232/485 0
(D) Setup Port 3
(E) TurnOffDelay 0 TurnOnDelay 0
(F) FlowControl 0

Slave radio-modem

Modem Serial Number 242-7581 SLAVE

SET MODEM MODE
Modem Mode is 4

(0) Point to Point Master
(1) Point to Point Slave
(2) Point to MultiPoint Master
(3) Point to MultiPoint Slave
(4) Point to Point Slave/Repeater
(5) Point to Point Repeater
(6) Point to Point Slave/Master Switchable
(7) Point to MultiPoint Repeater
(F) Ethernet Options
(Esc) Exit to Main Menu

SET BAUD RATE
Modem Baud is 38400

RADIO PARAMETERS

WARNING: Do not change parameters without reading manual

(0) FreqKey 5
(1) Max Packet Size 8
(2) Min Packet Size 9
(3) Xmit Rate 1
(4) RF Data Rate 3
(5) RF Xmit Power 10
(6) Slave Security 1
(7) RTS to CTS 0
(8) Retry Time Out 255
(9) Lowpower Mode 0
(A) High Noise 0
(B) MCU Speed 0
(C) RemoteLED 0
(Esc) Exit to Main Menu

The most important settings are displayed. The Slave security of the slave radio must be disabled: SlaveSecurity=1; The modem baud rate has to be 38400. The slave radio has to be in Mode 1 or Mode 4.

SpreadSpectrum 2.4 GHz radio telemetry

Setting the telemetry.

First communication and fluxstation-computer synchronization; The FluxStation clock can be not synchronized with the computer one; then, since the radio on/off is managed by the station a synchronization is necessary. That can be done using the PDA and the SetStation application or via computer.

The modem can work in point-to-point or in point-to-point switched mode:

Point to point

Set the master radio mode to 0: master;
Restart the radio modem and check that it is able to connect the slave radio: the CD light must become solid green.

Open the ***stations*** table on scada_data.mdb.

Change the TelemetryID field to **COM_1**

Check that on the ***telemetry*** table the record COM_1 has the fields **CommPort**=1 and **settings** = "38400,n,8,1";

Be sure that the radio is connected with the COM1: port of the computer and restart scada.exe. Wait that the CD light of radio is ON, then select {Call Now}.

If the communications will be successful the FluxStation clock is synchronized with the PC one and you're ready.

Point to point switched

Set the master radio mode to 6: master switched;

Open the ***stations*** table on scada_data.mdb.

Change the TelemetryID field to **SSR24**

Check that on the ***telemetry*** table the record SSR24 has the fields **CommPort**=1 and **settings** = "38400,n,8,1";

Be sure that the stations.TelemetryName is set to "2427581";

Be sure that the radio is connected with the COM1: port of the computer and restart scada.exe. Wait that the CD light of radio is ON, then select {Call Now}.

If the communications will be successful the FluxStation clock is synchronized with the PC one and you're ready.

SpreadSpectrum 2.4 GHz radio telemetry

Setting the telemetry.

Point to point switched with repeater

To understand the following information a base knowlege of the freewave operating mode is necessary.

Enter in the setup of master radio and :

Set the master radio mode to 6: master switched;

Open the call book entry of the radio;
Set the call book entry 0 by setting the 2427581 radio as slave to be connected, setting the correct sequence of repeater that must be used.

Open the ***stations*** table on scada_data.mdb.

Change the TelemetryID field to **SSR24**

Check that on the ***telemetry*** table the record SSR24 has the fields **CommPort**=1 and **settings** = "38400,n,8,1";
On the ***stations*** table search the record that define the station and set
Stations.TelemetryName is set to "**0**";

The Scada application, if the **telemetryID** is set to SSR24, when find a lenght one **TelemetryName** will use the command ATDT instead of ATD to call the **TelemetryName**, then it will use the CallBook data entry **0** instead of to call directly the slave radio.

I supposed to use the callbook entry 0 but it's possible to use another callbook in the range 0 to 9.

Be sure that the radio is connected with the COM1: port of the computer and restart scada.exe. Wait that the CD light of radio is ON, then select {Call Now}.

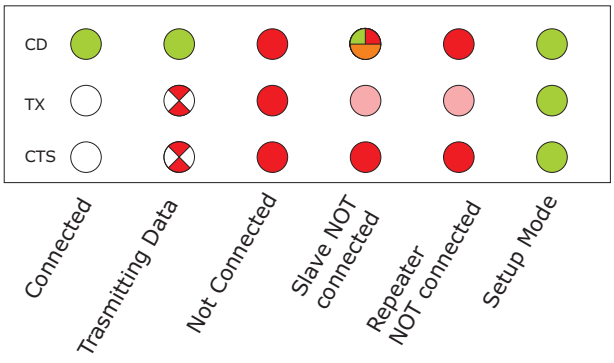
If the communications will be successful the FluxStation clock is synchronized with the PC one and you're ready.

SpreadSpectrum 2.4 GHz radio telemetry

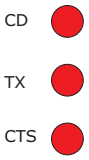
The radio-modem LED Lights

You can check the status of the link watching the LED lights on the radio-modem front panel. The meaning of the LED light depends on the function assigned to the radio-modem. The LED light status for the Master center radio is reported on the drawing below.

Master LED Status



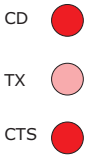
When you turn on the master radio-modem the 3 lights are solid red until the radio-modem connect to the repeater and the slave radio-modem.



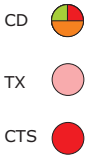
If the connection to the slave radio will be successfull the LED lights will be:

After the connection while trasmitting the data the LED lights become:

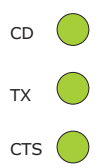
If the master radio-modem is NOT able to connect to the REPEATER the LED become:



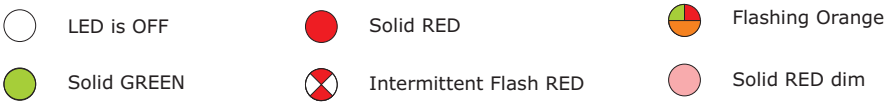
If the master radio-modem is able to reach the repeater but NOT able to connect to the SLAVE the LED become:



If you push the SET button to enter in the Setup Utility of the radio modem the LED light become:



LED Status legenda

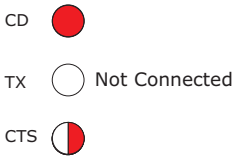


SpreadSpectrum 2.4 GHz radio telemetry

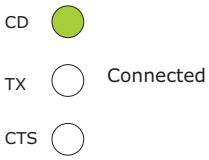
The radio-modem LED Lights

Slave LED Status

When you turn on the Slave radio-modem the 3 lights are as shown on the right until it will be connected to the master radio-modem via repeater.

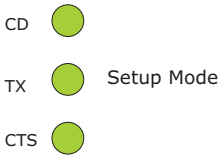


If the connection of the slave radio will be successfull the LED lights will be:



After the connection while trasmitting the data the LED lights become:

If you push the SET button to enter in the Setup Utility of the radio modem the LED light become:



LED Status legenda

CTS

- LED is OFF
- Solid GREEN
- Solid RED
- Intermittent Flash RED
- Flashing Orange
- Solid RED dim

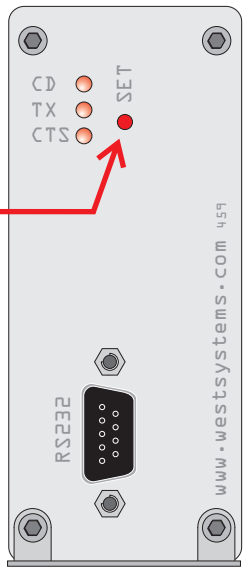
SpreadSpectrum 2.4 GHz radio telemetry

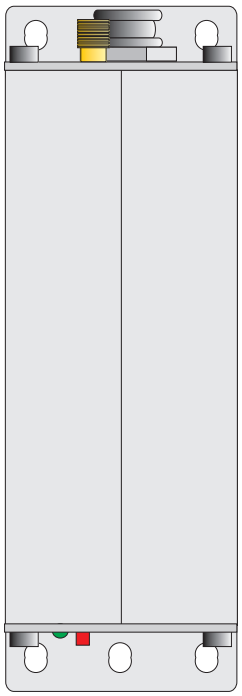
The radio modem

Status LED Lights

Set button (Press to enter in setup mode)

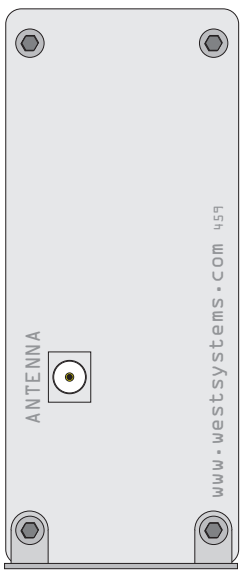
RS232 port DTE female





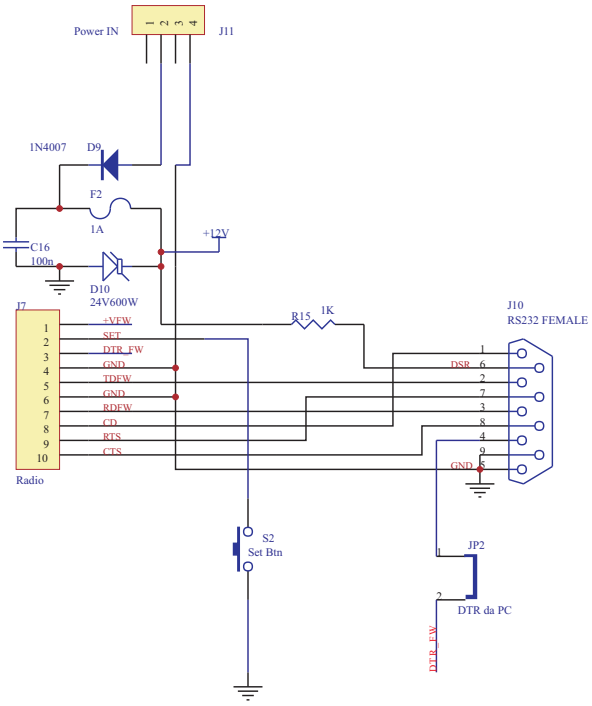
Power Supply inlet 10 .. 24 VDC,
max 1 Ampere @12 VDC

SMA Antenna connector 50 Ohm

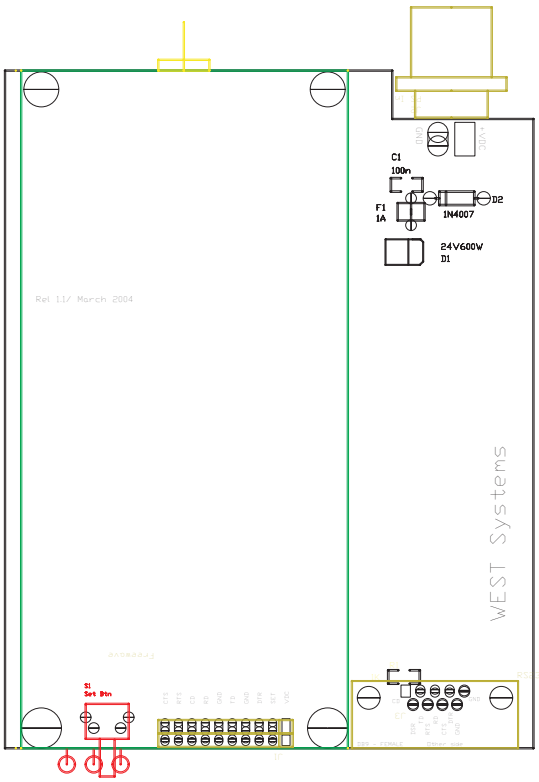


SpreadSpectrum 2.4 GHz radio telemetry

The radio modem interface schematic



The radio modem PCB layout



SpreadSpectrum 2.4 GHz radio telemetry

Pointing antennas

It's possible to use the CTS as raw signal strenght indicator;
Enter in the setup of the Master radio and change the **RF data rate** parameter to 1, and the Operation mode to 0 (master) then exit from the

RADIO PARAMETERS

(0) FreqKey 5
(1) Max Packet Size 8
(2) Min Packet Size 9
(3) Xmit Rate 1 (set it to 0 to point the antenna)
(4) RF Data Rate 3
(5) RF Xmit Power 10
(6) Slave Security 1
(7) RTS to CTS 0
(8) Retry Time Out 255
(9) Lowpower Mode 0
(A) High Noise 0
(B) MCU Speed 0
(C) RemoteLED 0
(Esc) Exit to Main Menu

No signal

When set to Xmit rate 0 the radio-modem will trasmit data back and forth continuously, and the strength of the signal may be gauged by the CTS LED light. A solid red CTS light indicate a strong signal, the less the KED is on the weaker the signal.

Then you can start searching the maximum signal rotating the antenna and searching the strongest signal. Remember that if the CD LED become RED you lost the link connection (No signal).

Very low signal

Medium signal

Because the radio-modems transmit countinuously when Xmit rate is set to 0 (wheter or not they have data to send) they use radio spectrum unnecessarily.. Therefore, xmit rate = 0 should be used only as a diagnostic tool and not for normal operation.

Strong signal

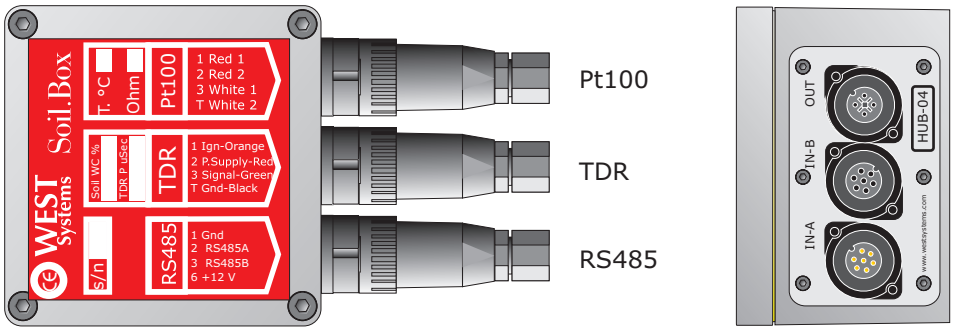
Remember to reset the "xmit rate" parameter to 1 and the operation mode to the original value

SoilBox

General description

The Soil.box is an hardware/software interface that convert the signal of Soil Temperature and of the Soil Water Content TDR CS616 sensor to a digital format compatible with the DF1A soilflux station.

The output of the Soil.box is a RS485 with the standard WEST Systems pin out. Since the SoilBox is designed to be the last device in the bus the RS485 line is terminated with a 120 Ohm embedded resistor.



Connections:

- RS485 --> IN A
- CS616 --> IN-B
- Pt100 --> OUT

Addresses

Description	LCD	Conf	Unit	LS	FS	ID0	ID1	ID2	ID3
Water Content %	TDR	A0	%	0	100	**1**	5	9	0D
Water C. Pulse	TDR RAW	A1	uSec	15	35	**2**	6	0A	0E
Soil temperature	6B13	22	°C	0	200	**3**	7	0B	0F
PT100 Resistance	6B13 R.	A2	Ohm			**4**	8	0C	10

Where:
LCD is the caption that the station display when the channel is selected.
Conf. Is the channel type
Unit is the measure unit.
LS is the minimum reading
FS is the maximum reading

The RED highlighted is the default set.
ID0 .. **ID3** are the base RS485 address of the device that you can set following the next table:

DIP SW	SW5	SW6	SW7	Addr 0
ID0	0	0	0	01
ID1	0	0	1	05
ID2	0	1	0	09
ID3	0	1	1	13

Dip SW 8 :Reserved for calibration / no actual function.

Please note that the soilbox is designed to works only with the CS616 CS water content TDR probe. The obsolete CS615 can not be used.

Please follow the instructions on the RS485 Expansion chapter of the station Handbook to configure the station.

Connectors pinout

Soil Temperature Pt100 Connections

Panel 3+T female connector

```
Pin 1:     Red 1
Pin 2:     Red 2
Pin 3:    White 1
Pin T:    White 2
```

If you're using a old Pt100 probe , supplied with the Rs485 HUB check that the pin T is connected to the White 2 wire of the Pt100 probe. If NOT please modify the Pt100 connection. A simple bridge between pin 3 and pin T can be enough , also if this simple solution can reduce the temperature measurement accuracy.

CS616 Connections

Panel 6+T female connector

```
Pin 1: Orange (Ignition)
Pin 2: Red (Power supply)
Pin 3: Green (Signal)
Pin 4: Black + Screen (Ground)
```

RS485 Connections

Panel 6+T male connector

```
Pin 1: Gnd   Black
Pin 2: A     Yellow
Pin 3: B     Green
Pin 6: +V12  Red
```

DIP switch settings

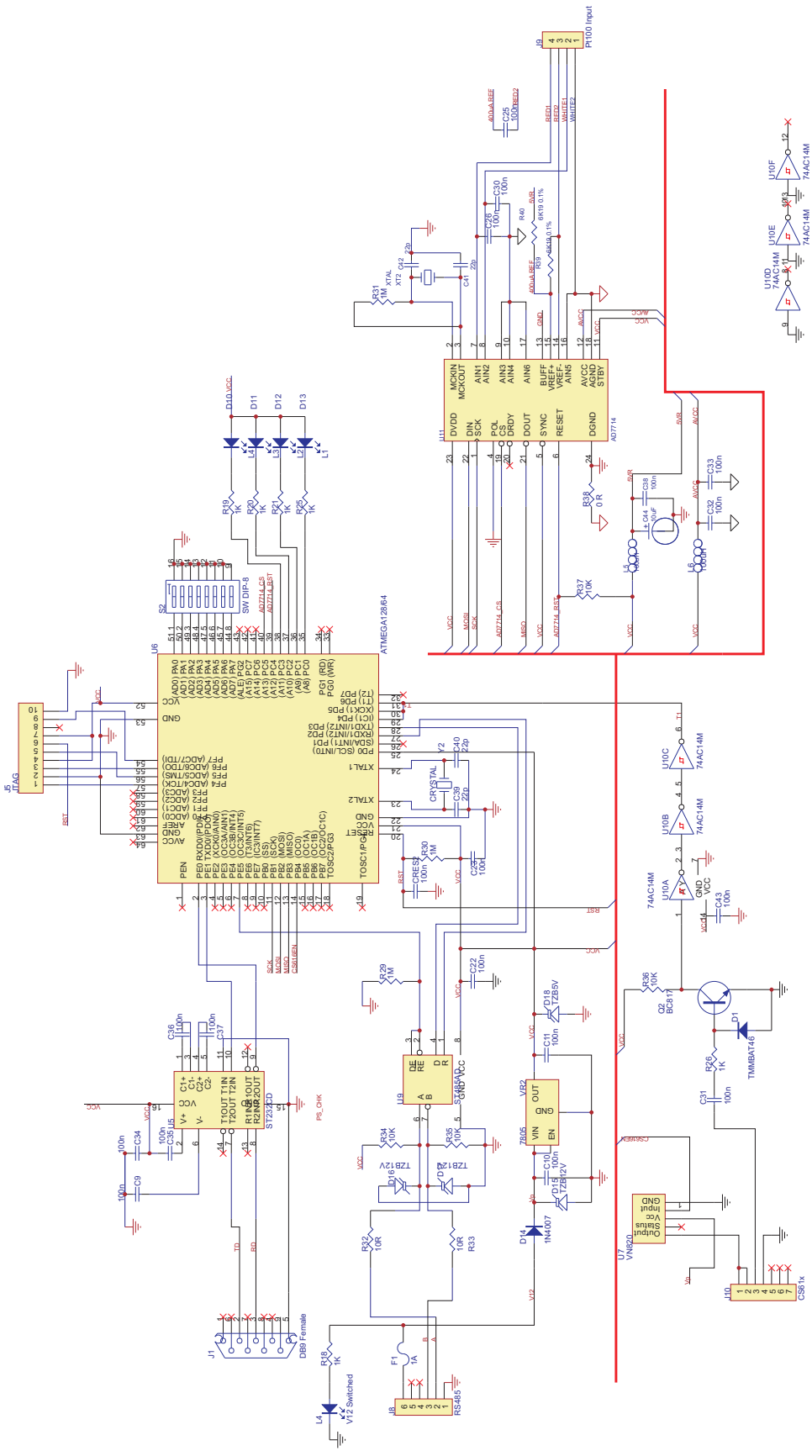
DIP SW	Enable/Disable	Factory Default
SW1	TDR	1
SW2	TDR RAW	1
SW3	6B13	1
SW4	6B13 R.	1

DIP SW	Enable/Disable	Factory Default
SW5	ID Set 0	0
SW6	ID Set 1	0
SW7	ID Set 2	0
SW8	Calibration	0

See page S.1

www.westsystems.com

Schematic

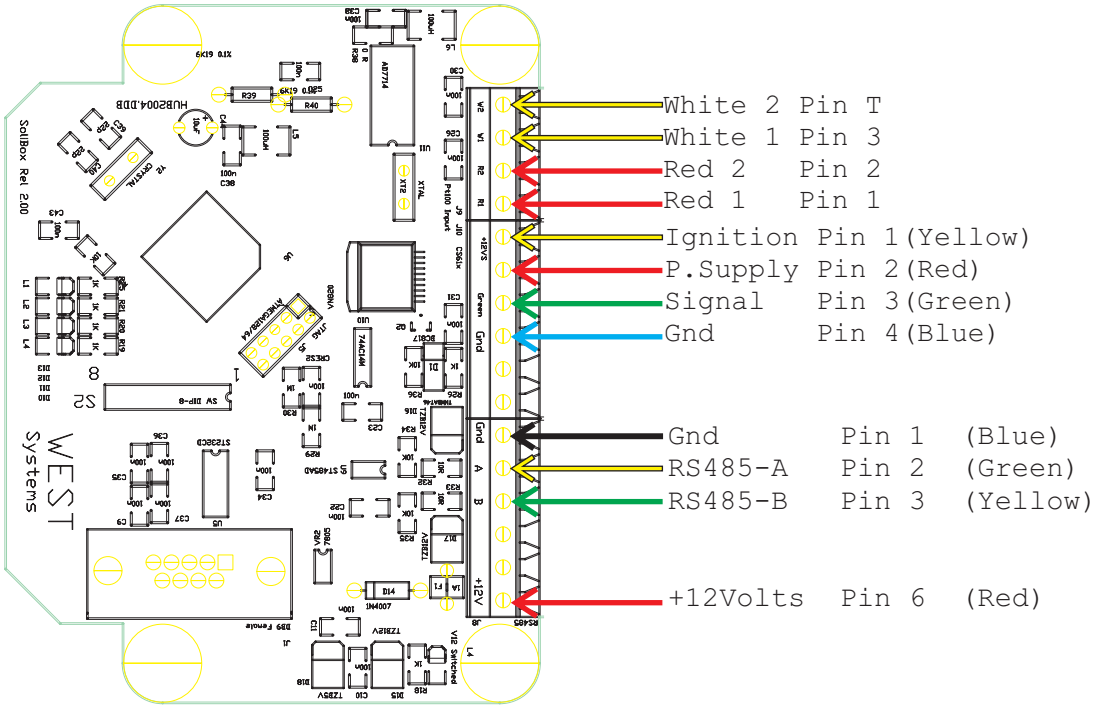


www.westsystems.com

WEST Systems SoilBox handbook Release 6.9 October 2004

SoilBox

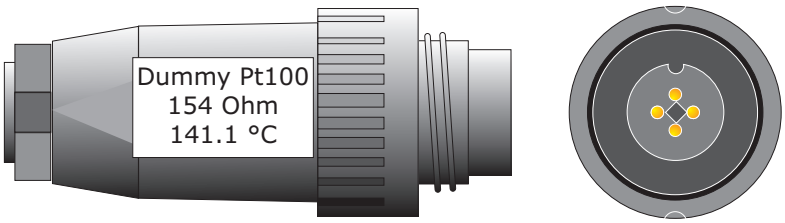
PCB Layout


White 2 Pin T
White 1 Pin 3
Red 2 Pin 2
Red 1 Pin 1
Ignition Pin 1 (Yellow)
P.Supply Pin 2 (Red)
Signal Pin 3 (Green)
Gnd Pin 4 (Blue)
Gnd Pin 1 (Blue)
RS485-A Pin 2 (Green)
RS485-B Pin 3 (Yellow)
+12Volts Pin 6 (Red)

Testing temperature channel

Connect the dummy Pt100 probe , you can ask with no charge to WEST Systems, to the soil box and check that the 6B13 channel reading is equal to the reading reported on the label attached to the dummy probe. The Dummy probe resistance has a tolerance of 1/1000 of the value reported on the label. The temperature reading error must be less than 0.5°C

WEST Systems provide a 100 Ohm (Zero degree Celsius) and a 154 Ohm (141.1°C) dummy probes.



To check the soil pt100 probe use a calibrated termocouple or pt100 (better) portable gauge and compare the reading with the station one. A 1.6°C tollerance must be acceptedt if you use a K termocouple, a 0.5°C tollerance is normal if you use a Pt100 probe.

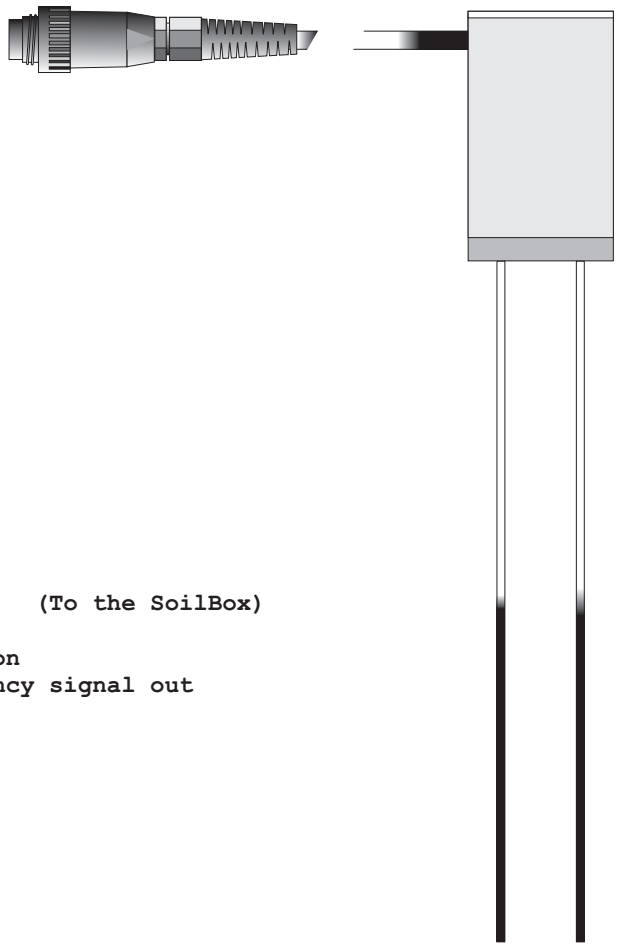
Testing TDR channel

The field test of the TDR is not possible. In order to have a valid data set avoid to extract the TDR probe from soil to do not perturbate the reading.

Soil water content

Manufatcurer : Campbell Scientific
Ordering code : . . . CS616 / CS615 (Out of stock)
Water content
Range 5-50 %
Accuracy 3%

The CS616 (CS615) Water Content Reflectometer measures the volumetric water content of porous media using time-domain measurement methods.
The Water Content Reflectometer consists of two stainless steel rods connected to a printed circuit board. A shielded four-conductor cable is connected to the circuit board to supply power, enable the probe, and monitor the pulse output. The circuit board is encapsulated in epoxy. The probe rods can be inserted from the surface or the probe can be buried at any orientation to the surface.
The CS616 (CS615) response is dependent on the dielectric constant of the material surrounding the probe rods. Water is the principal contributor to the dielectric constant value, but the solid constituents such as quartz, clay and organic matter also affect the measurement. The same calibration of volumetric water content to probe output signal period may not apply to all soils. Accuracy can be optimized by using calibrations derived for a specific soil. Accuracy of ± 2.0% over the entire water content range and for a wide range of soil types is routinely obtained in our laboratory. Applying the general calibrations from the operating manual provides accuracy of ± 3.0%.

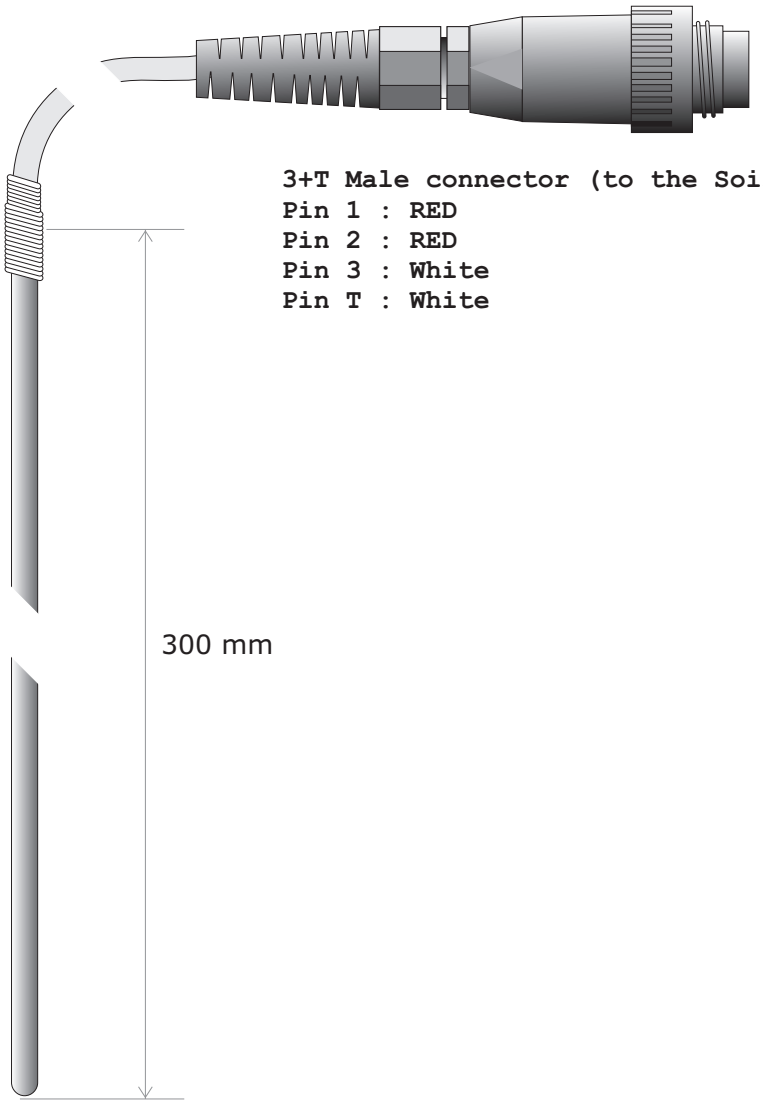


6+T Male cable connector (To the SoilBox)
Pin 1 : Red +12 Volt
Pin 2 : Orange Ignition
Pin 3 : Green Frequency signal out
Pin 4 : Black+Sh. Ground
Pin 5 : n.c.
Pin 6 : n.c.
Pin T : n.c.

SoilBox

Soil temperature

Manufatcurer : RS
Ordering code :RS 321-6090
Type : Pt100 DIN IEC 751 Class B 4 wires
Range 0 to 200 °C
Max operating temperature 200°C
Accuracy 0.3°C
Probe length 300 mm
Probe diameter 6 mm
Cable length 3 Meter
Cable PTFE and silicon insulated



3+T Male connector (to the SoilBox)
Pin 1 : RED
Pin 2 : RED
Pin 3 : White
Pin T : White

PDA software installation

The SetStation software is furnished by WEST Systems on two different support format:

- On the WEST Systems software CD
- On the Compact Flash data card.

Since the use of Microsoft ActiveSynch is not always so easy we advise you to setup SetStstion using the furnished CF compact flash (or SD secure digital) memory card.

PC based installation

1) Connect the palmtop to your computer using the USB or Serial craddle;
2) Start the communications with the palmtop using MS ActiveSynch;
3) Open "Windows Explorer" of your PC

4) Copy the file SetStation.exe file in the folder
\\Mobile device\PocketPC\Windows\Start Menu

"storage card" based installation

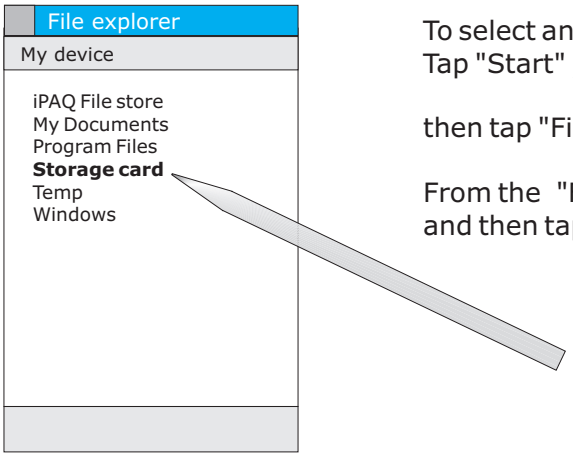
ACER n300

All Palmtops:

- Insert the Compact Flash / Secure Digital Card in the palmtop;
- Run "File Explorer" on your palmtop;
- Select the file "SetStation.exe" from the "Storage card";
- Copy the file SetStation.exe file in the folder "\Windows\Start Menu";

In the next page the CF / SD /MMC based installation is described in detail.

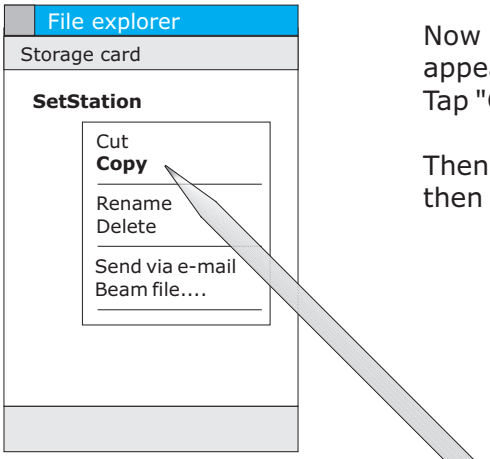
Software installation



To select and copy the file in the "storage card":
Tap "Start" , "Programs"

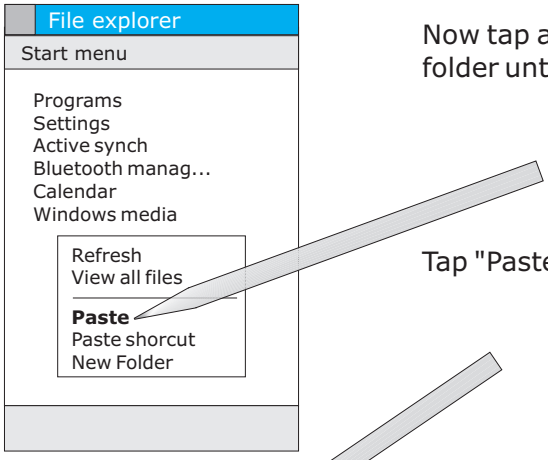
then tap "File Explorer".

From the "File explorer" menu tap "My Device" and then tap "Storage card"



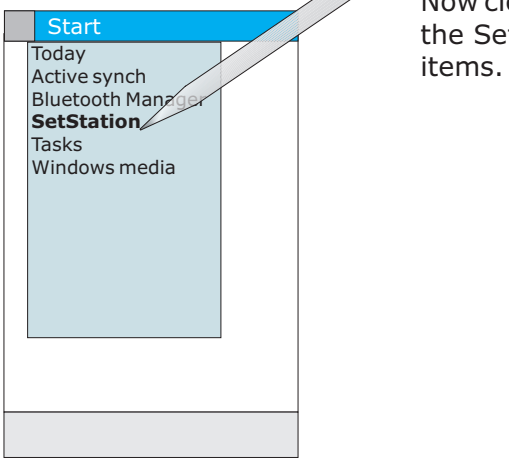
Now tap and hold SetStation until a flying menu appear.
Tap "Copy"

Then tap "Storage card" and select "My Device", then "Windows" and now "Start menu"



Now tap and hold in the white area of "Start menu" folder until a flying menu will appear.

Tap "Paste"



Now close all the applications and then tap "Start": the SetStation.exe will be one of the "Start" menu items.

Scada software installation

The Scada software is furnished by WEST Systems on the WEST Systems software CD.

Requirements

The Scada software suite requires the installation of the MS .NET Framework 2.0. To simplify the installation the computer must have an internet connection.

OS Requirements

The Scada software suite can run on MS Windows XP professional, MS Vista pro / business. We don't advise other OS such as XP Home or Vista Home.

First installation

Run ScadaSetup.msi

once finished the scada suite is ready to run.

Upgrades

Make a backup copy of scada_data.mdb and scada_log.mdb;

Using Control Panel disinstall the old Scada;

Run ScadaSetup.msi , preserving the old databases.

The new Scada suite is ready to run.

HandBook 10.0 released on November 2007

FluxStation HWR8 and Scada software suite

HandBook 10.1 released on December 2007

Some minor revision were introduced:
Chapter 2 : Assembly instruction
Appendix F: Page F.6 antenna assembly instruction

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Release 10.1 December 2007

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